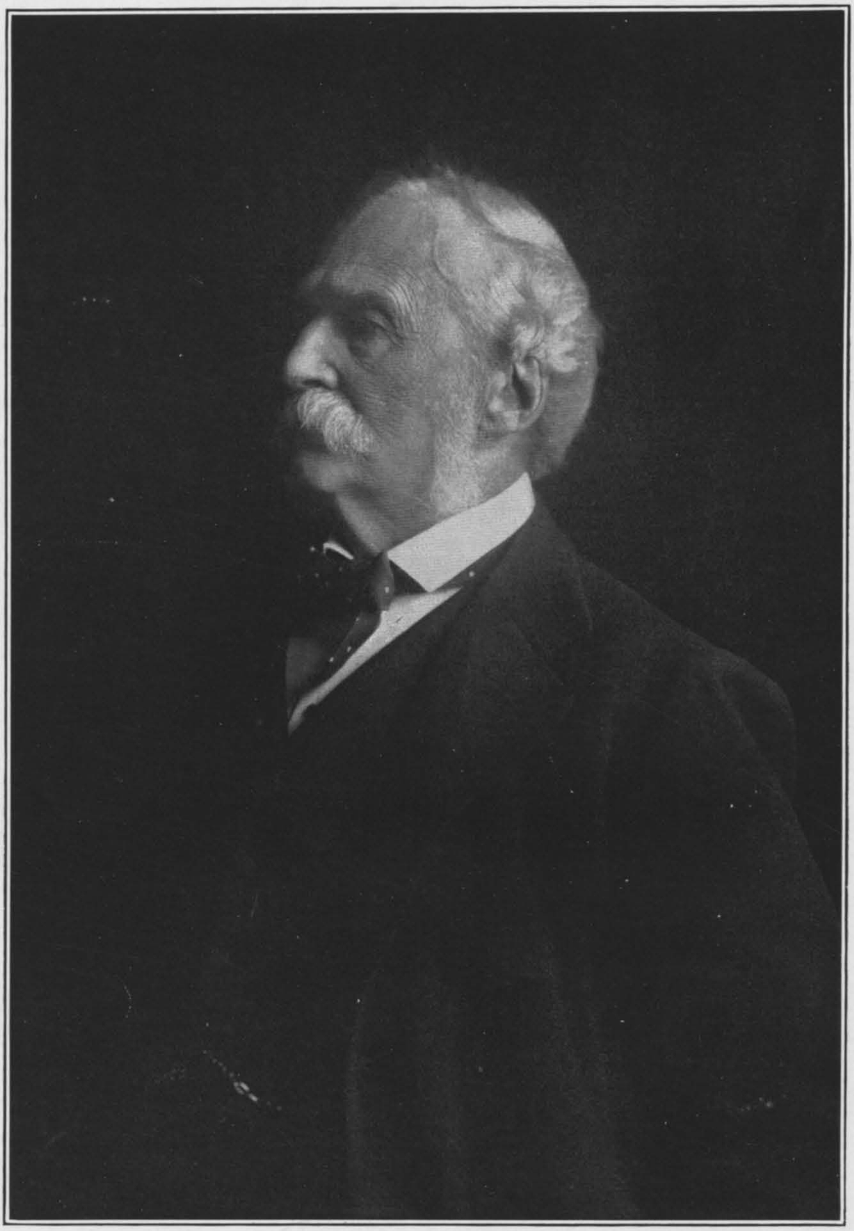

JAMES WALLACE PINCHOT.

BORN MARCH, 1831. DIED FEBRUARY, 1908.

[See page 495.]

YEARBOOK

OF THE

UNITED STATES DEPARTMENT OF AGRICULTURE.

1907.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1908.

[CHAPTER 23, Stat. at L., 1895.]

[AN ACT Providing for the public printing and binding and the distribution of public documents.]

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Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

PREFACE.

The Yearbook for 1907 does not materially differ in general character and arrangement from its thirteen predecessors. The general plan of the Yearbook, as originally designed and since developed by experience, is well adapted to the end in view, and is practically outlined in the law requiring its publication. No radical changes in its character are therefore attempted.

As usual, the Annual Report of the Secretary of Agriculture for the last fiscal year is included as the best and most practicable compliance with that feature of the law which provides that the Yearbook "shall include a general report of the operations of the Department."

In the main body of the volume an effort has been made, as heretofore, to secure suitable papers of high class dealing with various phases of agriculture, or containing practical information not heretofore published. This part contains twenty-seven different papers covering a wide variety of subjects, all prepared by officers and special investigators employed in the Department. A glance at the table of contents will show a number of reports on new lines of study and investigation.

Among the immense number of inquiries addressed to the Department during a year, many are answered by the Appendix to the Yearbook, and special effort has therefore been made to add to its value. This portion of the book may be roughly subdivided into three parts: First, it provides a directory for farmers, showing the organization of the Department; the organization and work of the agricultural colleges and experiment stations; State officers for agriculture; and officers of the principal organizations of the country whose objects and work closely identify them with practical agriculture or forestry. Second, it contains reports on the natural conditions affecting agriculture throughout the year, and on the progress made along certain lines. Third, it presents very full agricultural statistics. The first and second of these subdivisions are practically counterparts of the same features of previous years, though with added information and greater accuracy. The statistical tables are each year brought up to date by the inclusion of the most recent data, while the figures for several previous years are retained for purposes of comparison.

The increasing utility of the agricultural statistics has led to the retention of nearly all tables constructed in this Department for preceding Yearbooks and the addition of several new tables. One of these exhibits the wool clip of the principal countries of the world, and is believed to be the most nearly exhaustive table on this subject that has ever been compiled. Another is an original compilation showing the annual value of the agricultural exports from 1851 to 1907 and comparing this with the total annual value of all exports. Two other new statistical tables, made up from the results of a large and novel inquiry by the Department in all parts of the country, relate to the cost of hauling the chief crops from farms to shipping points.

This volume is illustrated by 66 plates (16 of which are colored) and numerous text figures. Every one of these illustrations bears a necessary relation to the text, supplementing and enforcing the descriptions given, and in some cases forcibly conveying ideas which it would be impossible to express adequately in words.

Economy in publication is the fixed policy of the Department, and in conformity with this policy every effort has been made by the Editor to secure brevity in the reports, papers, and tables of the Yearbook, and to exclude illustrations which, though they might add to the attractiveness of the book, would not enhance its instructional value.

The lively interest which the American people are just now beginning to show in the conservation of natural resources lends peculiar appropriateness to the frontispiece of this volume, an excellent likeness of the late James Wallace Pinchot. In a long and honorable career as a public man and private citizen, Mr. Pinchot did as much, perhaps, as any other man in America to promote the study and practice of forestry.

GEO. WM. HILL,
Department Editor.

WASHINGTON, D. C., *June 1, 1908.*

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YEARBOOK

OF THE

U. S. DEPARTMENT OF AGRICULTURE.

REPORT OF THE SECRETARY.

Mr. PRESIDENT:

I respectfully present my Eleventh Annual Report of the work of the Department of Agriculture for the past year.

It has been a year of untoward conditions requiring all the industry and skill of the farmers to grow an average crop. They have struggled not only with an erratic season but with a scarcity of help in all the States and Territories of the Union.

REVIEW OF PRODUCTION.

AVERAGE CROPS AND HIGHEST INCOME.

Such a year as 1907 has been, with its hard winter, summer weather in March, and late cold spring, gives exceptional emphasis to the wisdom of this Department's policy of diversifying farm products and of establishing new crops. A general crop failure in a field as large as the chief part of the Temperate Zone of a continent must be a rare occurrence.

No general crop failure afflicts the farmer this year, not even within small areas. The production of the farms, all things considered, is well up to the average of the previous five years in quantity, while its value to the farmer, as now appears at this annual day of reckoning, reaches a figure much above that of 1906, which by far exceeded any previous year's wealth production on farms.

Out of the farming operations of 1907, the railroads will get an average haul of freight, and foreign countries will take a heavy excess above home consumption. The farmer will have more to spend and more to invest than he ever before had out of his year's work.

DURUM WHEAT.

ITS INTRODUCTION.

When the Department of Agriculture brought durum wheat to this country from Russia and Africa during 1899 to 1902 the seed was sown that formed practically the entire foundation of the present

crop of durum wheat. At a cost of $10,000 in the beginning, a crop worth $30,000,000 now grows in regions of low rainfall, where in the day of stock ranges the steer roamed on 20 acres to find his living. This crop has encroached on the home of the prairie dog and of the cactus. It has spread throughout a wide strip of country, extending from northern North Dakota to southeastern New Mexico and northwestern Texas. It is a common crop in Montana and Idaho and in parts of Washington, Oregon, and Utah.

INDUSTRIAL USES.

This variety of wheat has entered into home industries. To a considerable extent it is mixed with other wheat in making flour for bread. It is promoting the manufacture of macaroni and kindred paste products in this country and is prepared as a breakfast food. It is the grain through which the desert feeds the cities of the east at home and abroad.

LARGE EXPORTS.

As an export crop durum wheat has become prominent. In 1905 Europe took nearly 10,000,000 of the 20,000,000 bushels produced; in 1906 about 20,000,000 bushels of the crop of that year.

Last year two-thirds of the exports went to Mediterranean countries. The former sheep and cattle ranges sent macaroni material to Marseille, Naples, and Venice; to Greece, Spain, and the countries of western Europe; and even to the old homes of durum wheat—northern Africa and Russia. Shipments of this wheat were made to 43 ports in Europe and Africa named in trade reports of the collectors of customs, and to other ports unnamed.

VALUE IS OVER TWICE THE COST OF THE DEPARTMENT.

With an average production of about 15 bushels per acre, durum wheat this year covered an area of over 3,000,000 acres, many of them valueless for agricultural purposes before the advent of this new crop. Its value to the farmer is over twice the entire cost of the Department of Agriculture during the current fiscal year, including the Weather Bureau, the costly meat inspection, and the Forest Service.

BEET SUGAR.

RAPID INCREASE.

The beet-sugar industry in this country had not advanced beyond experiment nor given promise of prominence until about 1888. Since that year it has rapidly grown, under aid and encouragement from the Department of Agriculture and the experiment stations and with favorable legislation by Congress and several State legislatures.

About 560 short tons of beet sugar were made yearly from 1879 to 1887; in 1891 the quantity was 6,000 short tons; in 1892, 13,460 short tons; in 1893, 22,344 short tons; in 1897, 45,246 short tons; in 1899, 81,729 short tons; in 1901, 184,606 short tons; in 1903, 240,604 short tons; in 1906, 483,000 short tons; and in 1907, 500,000 short tons.

ECONOMIC VALUE.

As an acquisition to agriculture much may be said in favor of growing sugar beets for the factory. Tillage must be of the best and the soil fertile. The pulp of the beets, after the extraction of the sugar, is relished by live stock. The crop is grown under factory-contract conditions, and the farmer knows upon what he may depend for profit.

FACTORIES AND LAND VALUES.

Sugar factories occupy a belt across the continent in the sugar-beet zone and a belt from Washington to Arizona along the Pacific coast. From the easternmost factory in western New York they extend through Ohio, Michigan, Illinois, Wisconsin, Minnesota, Kansas, Nebraska, Montana, Colorado, Utah, and Idaho; and from eastern Washington through Oregon and California to southern California and Arizona.

In 16 States there were 64 factories in 1906, with a capacity of working 49,500 tons of beets daily. Factories with more than three-fifths of this capacity are situated in the Western Division of States, and in that region this new crop has so well established itself and the growing of sugar beets has proved to be so remunerative that sugar-beet farms of the medium sort increased in value $42.49 per acre from 1900 to 1905, as determined by special investigation by the Department of Agriculture, or from $99.47 per acre in 1900 to $141.96 in 1905.

VALUE OF PRODUCT AND CAPITAL.

To the fostering of this industry by Nation and States, to the instruction provided by the Department of Agriculture, by experiment stations, and by agricultural colleges, it has responded by increasing the value of its production 543 per cent in nine years. The factory value of the refined sugar made in 1899 was $7,000,000, and in 1907, $45,000,000. More than $60,000,000 is now the value of the beet-sugar farms and factories.

One-third of the value of the beet sugar made this year would be enough to pay the cost of the Department of Agriculture during the current fiscal year and the National expense of the sixty experiment stations of contiguous United States when they shall have received the ultimate appropriation of the Adams Act.

ALFALFA.

IMPORTANCE AND VALUE.

Alfalfa, that extraordinary plant for producing wealth and doing wonders to farms, is occupying an important place in the plans of the Department of Agriculture, the experiment stations, and the agricultural colleges. Through their efforts largely it has rapidly gained success in cultivation throughout a vast area. The value of the crop as hay this year is supposed to be $100,000,000, and if the plans and efforts now under way to promote its extension receive a reasonable reward the value of the future crop will be several times the present amount.

MERITS OF THE PLANT.

This forage plant is a chemical laboratory in which nitrogen is taken from the air. It is a soil improver of the highest merit. As a flesh-forming feed for growing live stock, and as a milk and egg producer, it is unexcelled by any plant of large production.

It grows 2½ tons of hay to the acre as an average for the whole country where it is grown, or twice the average for all kinds of hay, and, besides this, is more nutritious than other hays.

EXTENSION.

The cultivation of alfalfa has been pressing eastward until now it has established itself as far as the longitude of eastern Kansas, except in southern Texas. It is established in some areas still farther to the eastward—in spots in Arkansas, in southern Wisconsin, northern Illinois, and northern Indiana, in the limestone regions of Kentucky and Tennessee, and in the southeastern corner of Michigan.

This plant is semi-established in Minnesota, Iowa, Missouri, and Ohio, and is making its way in Illinois and Indiana. Elsewhere the growing of this plant is mostly experimental, but with promise of success.

PRIZE WORTH HUNDREDS OF MILLIONS.

Further extension of alfalfa growing on large areas, by means of instruction by the Department of Agriculture, the experiment stations, and the agricultural colleges, is a prize that will be worth hundreds of millions of dollars yearly; and it will be won. What has already been secured aided in the rescue of the farm production of this year from the disasters of the weather.

IRRIGATION.

UNFAILING RELIANCE.

Among the large efforts that have the effect of giving steadiness to the agricultural production of the Nation at times of threatened adversity is irrigation. This is almost entirely confined to the arid

and semiarid regions west of the one hundredth meridian and to the rice coast of the Gulf of Mexico in Texas and Louisiana, but will move eastward as its value is learned.

AREA.

The area now under irrigation is 11,000,000 acres, or a surface equal to the improved farm land of Georgia, or Virginia, or Michigan, or equal to one-third of the cotton area.

VALUE OF CROPS.

At the census average income per acre, with allowance for subsequent increase of price of products, the value of the crops raised on irrigated land this year would appear to be worth at least $175,000,000, an increase of 75 per cent over the value of 1899.

In 1908 an additional area of 5,000,000 acres will be under ditch and ready for settlement. When this additional area is settled, the total will be 16,000,000 acres. If the new area were at once productive, the irrigated crops of 1908, at the price of 1907, would be worth $250,000,000, or more, and would support a population of over 1,000,000 persons.

SUMMARY OF CROP INTRODUCTIONS AND EXTENSIONS.

The foregoing striking features of the results of crop introduction and extension within the last few years are some of the illustrations of the wisdom of the great movement of the Department of Agriculture, of the experiment stations, and of the agricultural colleges, to fortify and buttress the agriculture of the Nation against misfortune, and to give to it a sort of insurance by multiplying the sources of success. This policy has done much to keep the production of 1907 not only from disaster, but, all things considered, actually to keep it up to an average of recent years.

VALUE OF THE DEPARTMENT'S WORK.

CONCERNED WITH WEALTH PRODUCTION AND PRESERVATION.

It is difficult to express in dollars the value of the work of the Department of Agriculture to farmers, and therefore to the Nation, but an attempt to do so was made last winter for the Committee of the House of Representatives on Expenditures in the Department of Agriculture, which made a total of $232,000,000.

Fundamentally the work of the Department is concerned with the production of wealth, as by increasing a crop yield per acre by plant breeding; and the preservation of wealth, as by suppressing insect and fungous pests; and with enabling farmers to make a fair sale of their products, as by promoting cooperative selling or by giving to the public information of the size of a crop in order that demand may be fairly adjusted to supply.

CHIEF CROPS.

CORN.

Four-fifths of the world's production of corn, as nearly as can be determined, grows in the United States, and in the world's international trade in corn this country contributes one-third to one-half of the exports, not including the products of corn-fed animals.

FACTOR IN NATIONAL PROSPERITY.—Corn is the chief of crops and exceeds every other prominent agricultural factor of national prosperity. It is a human food, and more especially a live-stock feed, with striking results. It is one of the great motive powers in the food of an energetic age. The starch of corn becomes the fat of the hog and the "finish" of the steer. No meat products are so much in demand in international trade as animal fats and oils. The value of these is more than one-half of the value of all exports of meat animals and packing-house products from this country. It is from four-fifths to nine-tenths of the value of these exports to Germany, to Italy, and to Norway and Sweden; and from two-thirds to four-fifths of these exports to France, and nine-tenths of these exports to Austria-Hungary, Denmark, and the Netherlands.

Fears of a failure or a large degree of failure of the corn crop this year diminished after midsummer and at last the harvest secured 2,553,732,000 bushels, a production that is almost exactly the average of the crops of the preceding five years. There have been three larger corn crops—those of 1899, 1905, and 1906.

ITS FABULOUS VALUE.—In value the corn crop of this year is much above the high-water mark of 1906. On the assumption that the crop will be sold by farmers at an average price not below the present one, its value is estimated to be $1,350,000,000, or 26 per cent above the average value of the previous five crops. Four crops before had exceeded one billion dollars in value.

The farm value of the corn crop of eight such years as 1907 would pay for duplicating every mile of steam railroads in the United States and pay for their costly terminals, rolling stock, and all property. In thirteen years it would replace the present banking power of this country in banking capital, surplus, deposits, and circulation, and in seventeen years it would replace the banking power of the world.

HAY.

Apparently the hay crop this year is more valuable than the cotton crop. On account of the varieties and qualities of hay its average price is difficult to determine without reports from crop correspondents. The computed value of the 61,420,000 tons of the crop is $660,000,000. The tonnage has been exceeded several times, but the value is $65,000,000 above the highest previous value, that of 1906.

Compared with the average of the preceding five years, the quantity of the hay crop of this year is 2½ per cent higher and the value is 20 per cent higher.

COTTON.

If the cotton crop of this year does not eventually occupy second place in value instead of hay in the final estimates of the Department, if seed be included, it certainly has third place, even without seed.

The farm value of the 1907 crop of cotton and its seed is estimated to be from $650,000,000 to $675,000,000. The commercial expectations are that the crop will be found to be the third one in size ever raised, and perceptibly larger than the average crop of the previous five years. Its farm value is probably a little below that of last year's crop. Otherwise it will be the most valuable cotton crop ever raised in this country and 7 per cent above the average farm value of the crops of the previous five years.

SUFFICIENT FOR THE WORLD'S NEEDS.—The year was a trying one to cotton from planting time to nearly the end of the summer, but even under adverse conditions a crop has been produced that will be sufficient, with the surplus of last year, to meet the requirements of spinners until the next harvest.

The fears of a cotton famine that followed the low production of this country in 1901 have not been justified, and in the meantime efforts to make European spinners partly independent of the Upland cotton of the South by aiding the growing of "colonial" cotton have not made themselves felt.

Outside of the British East Indies, the production of cotton in the British colonies, possessions, and protectorates was 7,553 bales of 500 pounds gross weight in 1904 and 10,016 bales in 1905. In the French colonies, except French India and Indo-China, 400 bales were produced in 1904; in the German colonies, 1,500 bales in 1905.

LOW COST OF TRANSPORTATION.—Among the strong points of advantage possessed by this country's cotton is the low cost of transportation to market. Recent investigations by this Department indicate that the average cost of transporting cotton per 100 pounds from farm to local shipping point is about 16 cents; from local shipping point to seaport, about 40 cents; and from seaport to the United Kingdom, about 32 cents; the total being only 88 cents per 100 pounds, or less than a cent a pound.

WHEAT.

Wheat, the fourth crop of the year in value, is deficient in quantity by 5 per cent when compared with the average crop of the preceding five years. The 625,576,000 bushels produced will be enough for a large per capita consumption, with a remnant of many mil-

lions of bushels for export, although not as many as usual. During the last five years the wheat exports, including flour, have averaged 122,411,110 bushels, and during that period 18.6 per cent of the crops was exported.

Although wheat is 5 per cent in quantity below the average crop of five years preceding, it is $5\frac{1}{2}$ per cent above the average value of these crops, or a little over $500,000,000. The crops of three years, 1901, 1902, and 1905, had a slightly higher value than this one.

OATS.

The only large crop to which a great degree of failure attaches this year is oats. Only 741,521,000 bushels were harvested and these were of low quality. In number of bushels this is the tenth oats crop ever grown in this country, and it is 19 per cent below the average crop of the previous five years.

In value the story is different. Contrasted with the loss of 19 per cent in quantity is a gain of 26 per cent in value in comparison with the five-year average; so that this year's crop is worth $360,000,000, or much more than the most valuable oats crop heretofore produced.

POTATOES.

The sixth crop in value is potatoes—292,427,000 bushels, worth $190,000,000. Three potato crops have exceeded this one in size—those of 1895, 1904, and 1906—but it is 2 per cent above the average of the previous five years. Its value is 26 per cent above the five-year average.

BARLEY.

Barley has pushed its way upward in production until it is now the seventh crop in value. The 147,192,000 bushels of this year are estimated to be worth $115,000,000. Only the crop of 1906 was larger, and the crop of 1907 is 2 per cent above the average of the previous five years. The value of barley this year indicates an extraordinary situation, the price per bushel being about double what it was last year; hence the value of the crop is about 85 per cent above the average of the previous five years.

TOBACCO.

The tobacco crop has declined to 645,213,000 pounds this year and is smaller than the crops of many years. It is 11 per cent under the average of the preceding five years, yet the value is the highest ever reached, except in 1906, and is estimated to be $67,000,000, or 16 per cent above the five-year average.

SUGAR, MOLASSES, AND SIRUP.

As farm crops, sugar beets and sugar cane are valued herein as such, except that the cane products are taken into account if the cane is crushed on the farm. The large cane-sugar mill is classed

with manufacturing instead of with agriculture; this is to preserve the census basis for comparison.

The farm value of the sugar beets in 1907 and of the sugar cane and sorghum cane and such molasses and sirup as were made on the farm is estimated to be $64,000,000. The sugar-beets value is slightly above the figure for 1906, and is 50 per cent above that for 1905, and twice the amount for either 1903 or 1904. The farm value of sugar cane, molasses, and sirup is estimated to be $33,500,000, which was exceeded only in 1904.

As a manufacturing industry.—The popular interest in this subject is so large that it is worth mentioning as a manufacturing industry. The raw cane-sugar mill production of 1907 is estimated at 389,000 short tons, with a factory value of $28,000,000, the year 1904 alone exceeding this amount. The estimate for refined beet sugar is 500,000 short tons, worth $45,000,000.

Both kinds of sugar add to 889,000 short tons, worth $73,000,000. When mill molasses and sirup and sorghum and maple products and beet pulp are added, the total value of the ultimate products of the sugar, molasses, and sirup industry (the refining of cane sugar not included) in 1907 is $95,000,000.

FLAXSEED.

The 25,420,000 bushels of flaxseed of this year's crop are worth about $26,000,000, the quantity being 5 per cent under and the value 3 per cent over the average of the previous five years. The crop of 1902 is the only one that exceeded this one in value.

RYE.

With a production of 31,566,000 bushels, or 4 per cent above the average of the five previous years, the rye crop has a value of $23,000,000, or 29 per cent above the five-year average. In three years, going back to 1891, the production has been greater, and the value has been higher in two years, 1867 and 1901.

RICE.

Rice is the twelfth crop in point of value this year and in both quantity and value is the record rice crop. The preliminary estimate is a production of 21,412,000 bushels of rough rice, or 963,540,000 pounds, an amount a little above the great crop of 1904 and 98 per cent above the average crop of the previous three years. This year's crop is worth $19,500,000 to the farmers, or 36 per cent above the three-year average.

The exports of domestic rice in the fiscal year following the crop year 1904 were 75,000,000 pounds of cleaned rice, 4,000,000 pounds in 1906, and 2,443,000 pounds in 1907. The imports of rice, less the

foreign and domestic exports, were about 64,000,000 pounds yearly from 1900 to 1903, and about 62,000,000 pounds in 1904. After the crop of 1904 the tide turned and in 1905 there were net exports amounting to 41,000,000 pounds, followed the next year by net imports of 43,000,000 pounds, and in 1907 of 61,000,000 pounds. The only year before 1907 when the production was greater than the consumption was 1904, and the production in 1907 is greater than in that year. The Department of Agriculture has been helping the rice grower to get better varieties from the Orient, which will change imports into exports.

BUCKWHEAT.

Buckwheat was a crop of larger production before 1860 than it has been in subsequent years, but it has revived during the last half dozen years. The production in 1907 is 13,911,000 bushels, or 4.7 per cent below the average of the previous five years, and its value is $10,000,000, or 14 per cent above the five-year average.

HOPS.

The hop crop has lapsed somewhat from its position in 1905 and 1906. The production of 1907 is estimated at 48,330,000 pounds, or 4.6 per cent below the five-year average, while the value of the 1907 crop is placed at a little less than $5,000,000, or 29 per cent below the five-year average.

TOTAL OF CEREALS.

Upon consolidating the seven cereal crops and comparing the production of 1907 with the average of the preceding five years, a loss of 214,000,000 bushels is observed, or 5 per cent. That is, the average of the five years was 4,349,000,000 bushels, and the production in 1907 was 4,135,000,000 bushels. The oats crop was 175,000,000 bushels under the average, and wheat 32,000,000 bushels, while rice was 11,000,000 bushels above, and rye and barley a little above.

Regarding corn as at the average of production and excepting oats, the other cereals show a net reduction below the five-year average of only 18,000,000 bushels, and this in a total production, omitting oats, of 3,393,000,000 bushels, so that the percentage of the net reduction is only one-half of 1 per cent.

In total value the seven cereal crops make a new high record that is above that of 1906 by $296,000,000. The farm value of the cereals of this year is estimated to be $2,378,000,000, or 23 per cent above the average of the previous five years.

SUMMARY OF CROPS.

In the production of crops the year 1907 has been a good one to all of the people as well as to the farmers. It has averaged with the previous five years after a general balancing of gains and losses.

A great fall in oats below the average and much smaller declines in wheat, tobacco, hops, flaxseed, and buckwheat have been counterbalanced, and more than that, by increases above the average in cotton, hay, barley, rye, rice, and potatoes. This means material commodities and not the value placed upon them.

No such high aggregate of crop values has ever before been reached by farmers as for the crops of 1907. In estimating these, little if any use is made of the high prices before the break in the latter part of October. The present indication is that every crop except hops will considerably, if not very much, exceed in value the average of the previous five years. Extremely large rates of gain are observed for corn, oats, barley, rye, hay, tobacco, potatoes, rice, and cotton seed, and the rates of gain would be notable in any ordinary year in the case of wheat, cotton lint, and buckwheat.

In the grand total income from his crops of this year the farmer finds himself in better financial condition than before. He reckons his income in ten figures and he is still improving his farm, buying bonds, lending to his neighbors, and putting his money into the vaults of banks.

TOTAL WEALTH PRODUCTION.

HIGHEST RECORD.

Wealth production on farms in 1907, as expressed in value, transcended the high record of 1906, which was itself much above the highest amount before reached. In arriving at the total the farm products of the year are estimated in value for every detail presented by the census and at that point in production at which they acquire commercial value.

The grand total for 1907 is $7,412,000,000. This is $657,000,000 above the value of 1906, $1,103,000,000 above that of 1905, $1,253,000,000 above that of 1904, $1,495,000,000 above that of 1903, and $2,695,000,000 above the census amount for 1899.

The value of the farm products of 1907 was 10 per cent greater than that of 1906, 17 per cent over 1905, 20 per cent over 1904, 25 per cent over 1903, and 57 per cent over 1899.

A simple series of index numbers shows the progressive movement of wealth production by the farmer. The value of the products in 1899 being taken at 100, the value for 1903 stands at 125, for 1904 at 131, for 1905 at 134, for 1906 at 143, and for 1907 at 157.

During the last nine years wealth estimated as above explained was created on farms to the fabulous amount of $53,000,000,000.

SEVERAL GROUPS OF PRODUCTS.

Besides the crops, there were farm dairy products in 1907 which nearly reached $800,000,000. The price of butter increased 4¾ cents a pound over 1906 and of milk three-fourths of a cent a gallon.

More than $600,000,000 must be regarded as the value of the poultry and eggs produced on farms in 1907. The amount may easily have been larger. This industry has advanced at such a rapid rate that no arithmetic can keep up with it. The farm price of eggs in 1899 was 11.15 cents per dozen as an average for the United States; in 1903, 12.37 cents; in 1904, 17.2 cents; in 1905, 18.7 cents; in 1906, 17 cents, and in 1907, 18.2 cents.

Dressed poultry in New York sold for 10.78 cents per pound wholesale in 1899, for 12.97 cents in 1903, for 12.57 cents in 1904, for 13.36 cents in 1905, for 13.2 cents in 1906, and for 14.9 cents in 1907.

The animals sold from farms and slaughtered on them in 1907 were worth about $1,270,000,000.

DAIRY, POULTRY, AND LIVE-STOCK COMPARISONS.

Dairy products are much more valuable than any crop except corn, and are equal to one-third of the value of all cereals.

The poultry products are worth more than the wheat and perhaps as much as the hay.

The live stock sold from farms and slaughtered on them is worth nearly twice as much as the cotton crop.

It is only by comparison that a glimmer of understanding can be given to such numbers as the foregoing. Enough is apparent, however, to make it plain that the farmer of the United States is in a business that counts for National welfare by providing the wherewithal on a scale of magnificence that defies the imagination to comprehend.

FOREIGN TRADE.

EXPORTS.

Food and fiber were provided in such enormous quantities in 1906 that a great National surplus went abroad to feed and clothe many millions in foreign countries. High prices helped to swell these exports as expressed in money, and for the first time in the history of the world a country exported agricultural commodities of home production to a value greater than $1,000,000,000.

In the year ending June 30, 1907, the domestic exports of farm products were valued at $1,055,000,000, or $79,000,000 above the high record of the previous year. Four-fifths of these were plant products, and chief among these was cotton, with a port value of $482,000,000, an amount much above the highest value of any former year.

The exported grain and grain products were valued at $184,000,000, the unmanufactured tobacco at $33,000,000, the oil cake and oil-cake meal at $26,000,000, the vegetable oils at $20,000,000, and

the fruits at $17,000,000. All were gains over 1906, except the item of grain and grain products.

Animals and animal products were exported to the value of $255,000,000, mostly composed of packing-house products, worth $203,000,000, or only $4,000,000 under the high-water mark of 1906. Exported live animals were valued at $41,000,000 and dairy products at $6,600,000.

Export movement mostly sustained by the farm.—The farm sustains most of the great export movement. If to the products that are fully agricultural are added those that are considerably so in combination with materials of other origin, and then are added the forest products and the commodities considerably composed of them, the remnant of the exports is but 28½ per cent of the total value of the record for 1907.

Cotton and its products are 29½ per cent of the total value of all exports; animals and animal products, 17 per cent; grain and grain products, 10½ per cent; all other exports sustained by agriculture, 6½ per cent; and the exports sustained by the forests are 8 per cent. Farm and forest together sustained 71½ per cent of the exports of 1907.

IMPORTS.

Agricultural products valued at $627,000,000 were imported in the fiscal year 1907, of which the plant products were $403,000,000, chief among these being sugar and molasses, valued at $94,000,000; coffee, $78,000,000; vegetable fibers, $62,000,000; fruits and tobacco, each valued at $26,000,000, and vegetable oils, with a value of $15,000,000.

Animals and their products were imported to the value of $224,000,000, with packing-house products, mostly hides and skins, valued at $96,000,000; silk valued at $71,000,000, wool at $42,000,000, and dairy products at $6,000,000.

FOREST PRODUCTS.

Never before 1907 were the year's exports of forest products so valuable as in this year. With an increase of $16,000,000 over 1906, the total of these exports ran up to $93,000,000, of which $52,000,000 was the value of lumber, $22,000,000 naval stores, and $18,000,000 timber.

On the other hand, the imported forest products were valued at $123,000,000, mostly composed of india rubber, valued at $59,000,000; lumber, valued at $21,000,000; gums, not including rubber, valued at $15,000,000; wood pulp at $6,000,000; and unsawed cabinet woods at $5,000,000. The total imports of forest products were valued at $26,000,000 above the total of 1906, which was the highest amount hitherto reached.

BALANCE OF TRADE.

The farmer is concerned in the Nation's balance of international trade, inasmuch as he provides the great bulk of the foreign credit which other classes of persons draw upon in the contrary movement of credit against this country.

The balance of trade in farm products in favor of this country in 1907 was $444,000,000, an amount that has been exceeded in only four years—1898, 1899, 1901, and 1902. In all other products the trade of 1907 produced a balance of only $2,500,000 in favor of this country.

Most of the foreign credit provided by farmers.—In eighteen years beginning with 1890 the farmers have not failed to secure a balance of at least $193,000,000, the low amount of 1895. The great aggregate of the 18 balances in the trade in farm products is $6,500,000,000, while the trade in other commodities during the eighteen years resulted in a grand adverse balance of $456,000,000.

A great stream of wealth has constantly been sent from farms to foreign countries to offset the adverse balance of trade in commodities other than agricultural; to pay the ocean freight costs on imports conveyed in foreign-owned ships; and to pay the interest, dividends, and principal on investments in the United States by foreigners. It is the farmer who has sent credit to expatriated Americans; it is he who has provided the immigrant with millions to send every year to the loved ones in the old countries; and, if there is still any credit to dispose of, the farmer has provided the American traveler in foreign countries with his pocket money.

THE FARMER'S THANKSGIVING.

The farmer has received much for which to be thankful. During the first half of the year he was threatened with general crop failure throughout the length and breadth of the country east of the Rocky Mountains. The very last day was exhausted that could be withheld from crop growth and still leave an average harvest.

Every necessary day for the development of the corn crop was worth 20,000,000 bushels of corn. Cotton needed a longer time and offered to pay 30,000,000 pounds of lint for the favor of each day of growth during the full term. Wheat offered over 6,000,000 bushels a day, tobacco 7,000,000 pounds, potatoes 3,000,000 bushels, and beets 6,000,000 pounds of sugar.

The entire wealth production of the farms was at stake and was dependent on a crop-growing season of sufficient length, and every one of its days was worth $50,000,000 to the farmer and to the Nation.

At the end of the harvest the farmer has provided the country with commodities that are equal to the average of recent years in

quantity and vastly more than are needed for National consumption. His labor and his knowledge have been rewarded with products the sum of whose value is $7,412,000,000.

The miner can not restore the mineral to the mine. With the farmer it is different. The primal forces and atoms of the universe are his. The sun shines and the rain falls and the farmer applies his art and science to inexhaustible resources, ever adding enormously to the country's wealth, capital, credit, and welfare.

WEATHER BUREAU.

The creation of a research observatory at Mount Weather, Va., and the gathering together of a highly trained staff of men for the study of meteorological problems marks an important epoch in the development of meteorological science in this country. One of the first results achieved by that staff was the sending of meteorological instruments, by means of aeroplanes, to a greater altitude than has hitherto been accomplished. On October 3, 1907, the world's record for high flights was exceeded. On that day eight kites, in tandem, carried the meteorograph to an altitude of 23,111 feet above sea level. Daily observations of upper-air conditions have been continued for over three months in succession, practically without interruption, and it is probable that this record will be maintained indefinitely in the future. The observations obtained in this manner are placed before the forecast official in Washington each night. The latter is thus informed of the vertical gradients of temperature and the direction of the wind for altitudes varying on the average from one-half mile to 2 miles. These facts are of great importance in the making of forecasts for the Middle Atlantic and New England States and for the elucidation of many problems of the upper air that hitherto it has been impossible to study.

WEATHER FORECASTS.

In the past forecasts of the weather, as is well known, have been based entirely upon the existing horizontal gradients of pressure and temperature at the surface of the earth. The formation of charts showing the distribution of temperature with increase of elevation above the earth's surface, which is now for the first time possible in our weather service, so graphically tells the story of the rise and fall of the thermal levels that the layman is able to comprehend their significance. It is apparent that when a comparatively deep stratum of abnormally warm or abnormally cold air persistently overlies a region the action of a moving cyclone or anticyclone on the weather experienced at the bottom of the atmosphere will be materially different from that which would be experienced were the upper air at a normal temperature.

The significance of these data from the view point of the forecaster is not yet fully understood, but certainly they present a fund of information that will be studied with profit by those whose duty it is to add to our limited knowledge of the science that must precede the art of weather forecasting.

The upper-air work at Mount Weather is thus described in detail because it is the one line of inquiry that at present holds out the greatest promise of immediate utility. The results already secured are deemed to be of such value that it is hoped means will be provided for the diligent prosecution of other lines of research work.

DESTRUCTION OF THE ADMINISTRATION BUILDING.

On the morning of October 23, 1907, the interior of the administration building at Mount Weather was discovered to be in flames. The fire spread so rapidly that the eight persons sleeping in the building that night barely escaped with their lives, two being seriously injured. It has been impossible to determine the origin of the fire. This building was used as an ordinary observing station such as is maintained at all of the various meteorological offices of the Bureau. It also contained the administrative offices and the kitchen, dining, sleeping, and general living rooms of the scientific staff.

When the structure is rebuilt it should be made entirely of fireproof material.

THE FORECAST SERVICE.

The forecasting service of the Weather Bureau continues to furnish useful information concerning the approach of untoward weather conditions, the occurrence of damaging floods in the rivers, and of severe storms on the Great Lakes and the seacoast. Within the last year or so the river and flood service has been strengthened in its weak spots and somewhat enlarged by bringing into the system rivers which previously had no service. As now constituted it embraces practically all of the great navigable rivers of the country and many others. In view of the general desire for the improvement of navigation on the larger rivers and the development of the resources of the country tributary thereto, a strong river service becomes more important than ever.

SEISMIC DISTURBANCES.

The seismic disturbances which have occurred since the San Francisco disaster have fully aroused the scientific world to the importance of systematically studying these natural phenomena.

Exact knowledge of the character and magnitude of the motion of the ground when subjected to earthquake action is of vital importance to those whose business it is to design and erect the high structures now so numerous in all of our great cities. Earthquake-proof construction must be required, especially in great structures,

even in regions which may seem to be immune; for probably it is only a question of time when some readjustment of the earth's strata under long accumulating stresses may occur in seemingly the most stable regions and an earthquake of greater or less severity be precipitated thereby.

Already action has been taken looking to the systematic study of earthquake phenomena by the formation of a National Bureau of Seismology in Strasburg, Germany. This organization is international in character.

It is submitted that this important work, since it affects the welfare of all the people, should be encouraged by the National Government, and that the Weather Bureau should be authorized to inaugurate and maintain systematic seismological observations within the United States and its Territories.

THE SALTON SEA.

The drying up of the Salton Sea, which now occupies a depression in the desert region of southern California, affords an opportunity of determining experimentally the rate of evaporation in the arid regions of the Southwest. In ten or fifteen years the sea will have disappeared, and in a somewhat shorter period its waters will have become so saline that its rate of evaporation will no longer be normal or representative.

RAINFALL AND EVAPORATION.

The two great factors which determine the amount of water available for purposes of irrigation are rainfall and evaporation. The Weather Bureau collects data of rainfall for all parts of the country, but nothing is being done on the evaporation side of the problem. The demand for accurate information respecting the rate of evaporation is most pressing from hydraulic engineers who are called upon to draw plans for the construction of water-storage reservoirs in the various parts of the country and under widely varying climatic conditions. In addition to the needs of the engineer, a knowledge of evaporation in different climates is recognized as an important factor in the economy of plant life. The agriculturist should have the advantage of the most accurate information obtainable as to the loss of water from the soil by this process.

Reservoirs already constructed by private persons have largely failed of their purpose by reason of a lack of knowledge of the amount of evaporation. The great irrigation projects now under way in the semiarid regions and those which may be planned in the future will be greatly benefited by the knowledge which is here sought.

The Weather Bureau, in cooperation with the United States Reclamation Service and the United States Geological Survey, should enter upon a research looking to a solution of the problem.

FOREIGN METEOROLOGISTS STUDY AMERICAN WEATHER SERVICE.

It is probable that no other branch of science is as much indebted to the researches of citizens of the United States as is meteorology, Redfield and Espy, early in the nineteenth century, having been the first to collect the data, plot it, and exhibit to the world the cyclonic action of storms. Utilizing the knowledge thus made known and the further researches of the scientists of other nations, the United States has taken the lead in the practical application of meteorological science, our broad continental area and thorough electrical communication rendering it possible to bring an extensive system under one administrative head. The service is the result of an evolution, it being necessary to adopt new methods with each advancing step and to devise and invent appliances for the putting into effect of ideas that were unique. It has also required the application of discipline of military exactness in order to coordinate into an efficiently working machine 200 full meteorological offices with more than 900 auxiliary stations, and to produce an efficiently working unit that shall twice daily gather meteorological data from such a large area, collate and print it at many commercial centers, and, through the agencies of the press, the telegraph, the telephone, and the rural free delivery, place the deductions from the data before those who can make the most use of them.

Within recent years many scientific representatives of foreign governments have honored us by visits and by a study of the methods employed by the United States in the administration of its Weather Bureau.

BUREAU OF ANIMAL INDUSTRY.

THE MEAT INSPECTION.

The Federal meat inspection has been greatly extended and improved under the new law of June 30, 1906, and is now on a higher plane than ever before. Public confidence, which was unsettled by the agitation of the previous year, has been restored. The important matters of sanitation of slaughtering and packing establishments, preparation of meats and products, use of chemicals, preservatives, etc., and prevention of fraudulent labeling are now controlled and regulated, whereas formerly the Department had no authority over them, but was practically confined to an inspection before and at the time of slaughter to determine the health of the animals. The interstate transportation of meats and meat food products is also now under control.

Naturally a very marked increase has occurred in this branch of the work, as compared with the preceding year. Inspection was conducted at 708 establishments in 186 cities and towns during the fiscal year 1907, whereas in 1906 the corresponding totals were 163 establishments and 58 cities and towns. The number of employees engaged

on meat inspection July 1, 1906, was 981; on July 1, 1907, this force had been increased to 2,290.

The meat inspection covered 50,999,034 animals, practically all of which were inspected both before and after slaughter. Of these, 149,792 carcasses and 529,876 parts were condemned for disease or other cause. The cost of this inspection was $2,159,474.12. While, therefore, all of the $3,000,000 appropriated by Congress for this purpose was not expended, it should be borne in mind that the law was in full force but nine months of the fiscal year, and that the service was constantly expanding during the year. The rate of expenditure during the first half of the period was considerably below the normal requirements under the new law. By using in the marking of meats a metal stamp with special ink prepared by the Department, instead of the label formerly employed, a saving estimated at half a million dollars a year is being effected.

In addition to the veterinary inspection there is a subsequent inspection of the meats and products, consisting of an examination by experts in the curing of meats and a laboratory inspection to determine the bacteriological and chemical condition of the finished products. For carrying on this work laboratories have been established at New York, Chicago, East St. Louis, Kansas City, Omaha, and San Francisco. As a result of this inspection more than one hundred different varieties of products which had been in circulation prior to the new act were found to be in conflict with it. Since then, however, the examinations show that as a general rule the packing houses have been complying with the law in regard to preservatives and coloring matter, and also in regard to proper labeling.

The microscopic inspection for trichinæ, which has heretofore been applied to pork intended for export to countries requiring such inspection, has been discontinued. The experience of this country as well as of Germany has shown that under practical conditions a reliable inspection for trichinæ is not possible, as it is sometimes necessary to examine a carcass microscopically as many as twenty or thirty times before the parasites are found. Germany, while requiring our certificates of microscopic inspection, was not willing to accept them as conclusive, but reinspected all pork imported from the United States. As the inspection seemed to be of little or no benefit, but of considerable expense, it was stopped. The microscopic inspection for trichinæ has never been carried on or considered necessary for the protection of the American public, as thorough cooking or thorough curing kills the parasites, and it is not the custom of Americans to eat pork in a raw, uncured state.

As it is often difficult to determine just where to draw the line between what should be passed and what condemned in meat inspection, especially where carcasses are affected in some degree with tubercu-

losis, a commission of experts outside of the Department was appointed to consider and advise with regard to those portions of the Department's meat-inspection regulations relating to the disposal of carcasses affected with various diseases and abnormal conditions. This commission consisted of Dr. William H. Welch, professor of pathology, Johns Hopkins University, chairman; Dr. L. Hektoen, professor of pathology, University of Chicago; Dr. M. J. Rosenau, director of the hygienic laboratory, United States Public Health and Marine-Hospital Service; Dr. Joseph Hughes, president of the Chicago Veterinary College; Dr. V. A. Moore, professor of comparative pathology, Cornell University; Dr. Leonard Pearson, dean of the veterinary department of the University of Pennsylvania, and Dr. Charles Wardell Stiles, chief of the division of zoology, hygienic laboratory, United States Public Health and Marine-Hospital Service, secretary.

The report of the commission has been received and is being considered in the preparation of revised regulations. The general conclusion with regard to the portion of the regulations under consideration was that "if there be any general error in the regulation this is in favor of the public rather than in favor of the butchers and packers."

While the Federal inspection insures the wholesomeness of the product of establishments doing an interstate and export business, the Federal power can not reach the numerous small, local establishments whose product is sold entirely within a State. Some of the worst conditions have been found at places of the latter kind, and the tendency of a strict inspection is to cause diseased and unfit animals to be sent to slaughterhouses having no inspection. If the public is to be fully protected, the Federal inspection must be supplemented by State and municipal inspection. An inspection such as is carried on in some places—consisting merely of an examination of meat as offered for sale in the market and the condemnation of any that may be tainted or spoiled—is not sufficient. The purchaser can usually detect spoiled meat. What is more important is a careful veterinary inspection of all carcasses at the time of slaughter, to exclude those which are diseased. There is great need for the States and municipalities to apply such an inspection at all places not under Federal supervision. In the meantime the Federal inspection label offers to the consumer a guaranty that the meat bearing it comes from healthy animals and has been prepared under sanitary conditions.

INSPECTION OF EXPORT ANIMALS.

The inspection of the Bureau of Animal Industry also extends to the export trade in live stock. Animals to the number of 536,291 were inspected for export, and 484,254 were again inspected on

arrival at British ports by Bureau inspectors stationed there. Seven hundred and forty-one inspections were made before clearance of vessels carrying export animals, and they were required to conform to certain regulations as to space, fittings, attendants, feed, water, ventilation, etc. The losses of animals in transit were only about one-quarter of 1 per cent.

ERADICATION OF THE CATTLE TICK.

The progress made in the eradication of the cattle tick which transmits Texas fever demonstrates that the ultimate extermination of this costly pest is entirely practicable, if Congress and the State legislatures will provide the necessary means. The great benefit which will accrue to the cattle industry of the South, and incidentally to the country at large, from the success of this work will abundantly justify the necessary expense.

The work of tick eradication was not actively begun until July 1, 1906; yet as a result of work done to October 31, 1907, there have been, or will in the near future be, released from quarantine certain areas in Virginia, North Carolina, Georgia, Tennessee, Arkansas, Oklahoma, Texas, and California, amounting to approximately 60,000 square miles, and good headway has been made in still other areas. The work has been pursued in cooperation with State authorities in the States above named and in South Carolina, Alabama, and Louisiana. Complete returns to October 31 last show that during the first ten months of the present calendar year this work has included 2,307,934 inspections and 775,795 disinfections of cattle. Various approved methods for the eradication of ticks have been used, including pasture rotation and dipping, spraying, and hand-dressing with oil and oil emulsion.

CONTROL OF CONTAGIOUS DISEASES.

The number of cattle moved from the area quarantined for Texas fever to northern markets during the quarantine season of 1906 was 1,000,629, shipped in 36,213 cars. These cattle were all for immediate slaughter and were handled under the supervision and regulations of the Department. There were also inspected in the provisionally quarantined areas of Texas and Oklahoma 126,238 head of cattle, which were permitted to be moved north for purposes other than immediate slaughter. Supervision was exercised over 137,902 dippings in crude petroleum and over the cleaning and disinfection of 36,895 cars.

The prevalence of sheep scab has been considerably reduced, and since the close of the fiscal year the quarantine for this disease has been removed from Wyoming and Idaho, and it is expected that later it may be removed from Utah. Such headway has been made as to

give hope that, with another year's work, the disease may also be eradicated from Colorado, New Mexico, and Arizona. The total number of inspections of sheep for scabies was 62,625,831 (including 68,264 goats inspected for scabies at slaughtering centers), and the total number of dippings was 12,133,466, of which 2,640,408 were redippings.

The eradication of cattle mange or scabies is being continued, but has been retarded in some localities by the removal of fences from the public domain in conformity with an act of Congress, and by conditions on the open range where cattle travel great distances and mingle without restraint, making it easy for disease to spread and difficult to enforce proper sanitary measures. Under these circumstances it was found necessary to adopt more stringent regulations for the suppression of the disease, and better results are expected. During the fiscal year 1907 there were 15,243,323 inspections of cattle for scabies and 466,623 dippings. It would be of great advantage in combating contagious diseases of live stock if the public-land laws were so amended as to permit the leasing and fencing of the public domain so that owners might have better control over their animals and the promiscuous mingling of stock be largely prevented.

Although the troublesome venereal disease of horses known as maladie du coït or dourine, which prevailed in several of the Western States, was stamped out a year or more ago, owing to the insidious character of this disease it was thought best to continue inspection in the previously affected territory to make sure that no trace of the contagion remained. Nearly 15,000 inspections were made during the fiscal year, and all suspected cases of which information was received were investigated, but without finding a single case of the disease. It therefore seems certain that as the result of diligent work for several years this disease has been completely eradicated and that there will be no recurrence of it unless the contagion is again introduced from abroad.

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

A careful system of inspection and quarantine of imported animals is maintained in order to protect our domestic live stock from the contagion of destructive animal diseases which are found in other parts of the world. All animals offered for importation are required to be inspected, and certain kinds when coming from certain countries are required to be quarantined for a sufficient period to insure their freedom from contagion. Cattle are required to pass the tuberculin test for tuberculosis. During the fiscal year 147,897 imported animals were inspected, and of these 1,448 were quarantined. Blood tests are made of animals whose origin is such as to make it at all probable

that they carry in their blood the causative agent of surra, a destructive disease which prevails in the Orient. In an importation of 51 cattle from India 17 were found to harbor this micro-organism and were destroyed. It is fortunate that the disease was detected and that the affected animals were slaughtered before the contagion could be introduced into this country. The absolute prohibition of the importation of all species of animals likely to harbor the parasite, from the sections where the disease exists, seems the only safe plan.

TUBERCULOSIS INVESTIGATIONS.

Tuberculosis has continued to be the subject of special investigations by the Bureau of Animal Industry. Further work has confirmed the view that the location of tuberculous lesions in the body is quite independent of the point at which the infectious material enters, and that the frequency with which tuberculosis occurs as a lung disease justifies the conclusion that the lung is not always infected directly through the air.

The work of the year also demonstrated that the commonest mode for the discharge of tubercle bacilli from the bodies of tuberculous cows is with their feces, that about 40 per cent of the tuberculous cows that show no outward symptoms are expelling and scattering tubercle bacilli, and that tubercle bacilli passed with the feces of tuberculous cows are actively pathogenic. When it is borne in mind how frequently milk contains cow feces, and that the percentage of dairy cows known to be tuberculous is considerable, the facts presented seem to warrant the conclusion that tuberculous cows are responsible in a great measure for the prevalence of tuberculosis in the human family.

During the past year there has been considerable agitation in the District of Columbia with reference to the improvement of its milk supply. The Commissioners of the District appointed a committee or conference composed of scientists, physicians, veterinarians, milk producers and dealers, attorneys, and business men to consider methods for obtaining pure and wholesome milk and to advise as to proper legislation to that effect. In order to assist in this work, the Secretary of Agriculture, about April 1, directed the Bureau of Animal Industry to apply the tuberculin test to the herds of all dairymen who might request such action. In tests made by the Bureau and by the health department of the District of Columbia, covering 37 herds with 658 cattle, 18 per cent were found to be tuberculous. Some of the reacting animals had every appearance of being in good health, and several of this kind were removed to the Bureau Experiment Station, where it was found that they were discharging tubercle bacilli in great numbers and that their milk produced tuberculosis in guinea pigs.

The examination of sediment taken from the cream separators of public creameries throughout the country has demonstrated the presence of tubercle bacilli in about one-fourth of the samples. These creameries must be regarded as an important source of tubercular infection for the hogs and calves that are fed upon the separated milk that is returned to the farm from the creamery. State laws should be enacted requiring the sterilization of all milk and other products before they are returned by the creamery to the farmer for use as food for live stock.

The length of time that tubercle bacilli will live and retain their virulence in butter under usual market conditions is also being made a subject of investigation, but the work has not proceeded far enough to give definite results.

For the past five years careful and extensive scientific studies have been made of the comparative characters of human, bovine, and avian tubercle bacilli, and the results have been published.

The immunization of cattle against tuberculosis is being investigated.

HOG CHOLERA INVESTIGATIONS.

Continued experiments with hog cholera have again demonstrated that the contagion consists of a virus which exists in the blood and other fluids of diseased animals, but which can pass through the finest filter, is invisible under the microscope, and therefore can not be isolated or discerned by any of the usual methods.

The method of immunizing hogs against cholera, to which reference was made in last year's report, has been tested much more extensively, and the results show quite clearly that a comparatively certain method of protecting hogs from this disease has been secured. Hogs that have recovered from the disease or that have been exposed without contracting it are injected with suitable amounts of virulent blood from diseased hogs, and thus their immunity is heightened. The blood serum of these immunes is then used in vaccinating the hogs which it is desired to protect. The method giving the best results is to inject blood from diseased hogs simultaneously with the immune serum. By this method of vaccination hogs are protected for three and a half months or more, while by the use of the serum alone the protection can not be expected to last longer than three weeks. The immunized hogs probably retain for several months their power to furnish a potent serum. The serum probably can not be used successfully as a curative agent unless administered within four days after actual infection has taken place.

In order that this method may be more extensively tested, it is expected to make arrangements for the State experiment stations to test serum which will be furnished to them by the Department. It is hoped that the practicability of this method for combating hog cholera may thus be determined within a short time.

OTHER PATHOLOGICAL WORK.

Rabies continues to prevail in many parts of the country. When requested the Bureau examines suspected cases and makes diagnoses. During the year 47 post-mortem examinations were made in the pathological laboratory, and in 27 cases (all dogs except two—a sheep and a cat) the diagnosis was positive. Twelve of the positive cases were from the District of Columbia, 6 from Virginia, 5 from Maryland, and 1 each from Maine, Wisconsin, North Carolina, and South Carolina. In addition, several cases were investigated at the Bureau Experiment Station, and some of the animals which had been bitten were kept under observation and the disease studied as it developed in them.

A disease of the bobwhite, somewhat similar to grouse disease in Great Britain, appeared in several sections of the country, and as it seemed to threaten extensive destruction to this popular game bird an investigation into its cause and nature was promptly undertaken, and a preliminary report was published to assist in combating it.

The importation of cattle from India, before mentioned, some of which were found to carry in their blood the minute parasite which is the specific cause of the disease known as surra, afforded an opportunity for a study of that disease. Much was learned of its character and of the remarkable periodical development of the living parasites within the blood of the affected animals.

Among other lines of work in progress is an investigation of swamp fever in horses in cooperation with the Minnesota Experiment Station. The results so far indicate a probability of obtaining a satisfactory treatment for the disease.

WORK ON ANIMAL PARASITES AND PARASITIC DISEASES.

In the first series of field experiments in connection with a study of the life history of the roundworms of sheep, with the view of determining if possible methods of preventing infection, a system has been worked out by which lambs may be raised free from hookworms and stomach worms, and the length of time during which infection persists in pastures under certain climatic conditions has been determined. This information has been published.

An investigation of the distribution of the gid parasite of sheep in Montana shows that it is widely prevalent there. A comparison is also being made between specimens of gid parasites of American and European origin, in order to determine whether the two are of the same or different species.

An investigation is in progress concerning the so-called "palisade worm" disease of horses, which occasions the loss of a large number of animals annually in Wyoming and neighboring States.

SHEEP DIPS.

Cresol dips and coal-tar creosote dips to be used in the official dipping of sheep for scabies have been added to the two classes of dips previously sanctioned for this purpose, namely, the lime-and-sulphur and tobacco-and-sulphur dips. A large number of proprietary substances belonging to these four classes have been submitted for examination, and permission has been granted for the use in official dipping of those which were found to conform to the prescribed standard.

DISTRIBUTION OF BLACKLEG VACCINE, TUBERCULIN, AND MALLEIN.

The distribution of vaccine to prevent blackleg in cattle has been continued with good results, about 1,250,000 doses having been prepared and distributed to stock raisers during the fiscal year. This disease is becoming much less of a menace to young cattle than it was some years ago, when the mortality without vaccination amounted to over 10 per cent in certain sections. It is evident that the vaccine in a few years has not only saved many animals to the breeder, but has gone far toward the eradication of blackleg from the pastures of the country.

Tuberculin and mallein, for the diagnosis of tuberculosis in cattle and glanders in horses, are furnished to official veterinarians and health officers. During the year 129,050 doses of tuberculin and 41,012 doses of mallein were prepared and sent out, more than half of the mallein being furnished to the War Department.

ANIMAL HUSBANDRY WORK.

Experimental work and investigations are being carried on by the Bureau of Animal Industry in connection with the breeding of horses, cattle, sheep, and poultry, besides some small animals, and in the feeding of hogs, cattle, and poultry, most of the work being in cooperation with State experiment stations.

HORSE BREEDING.

The work in the breeding of American carriage horses, in cooperation with the Colorado Experiment Station, is progressing satisfactorily. During the fiscal year 11 foals, the progeny of selected parents, were dropped—2 males and 9 females. No additional horses were purchased.

The work in breeding Morgan horses, which is being carried on in cooperation with the Vermont Experiment Station, has been greatly extended through the generosity of a public-spirited citizen of Vermont, who donated to the Department a farm of 400 acres near Middlebury, to be used in these operations. There were in the Vermont stud on July 1, 1907, 1 stallion, 9 brood mares, 1 two-year-old filly, 8 younger fillies, and 1 weanling colt.

SHEEP BREEDING.

There is great need of a breed of sheep suitable to the range conditions of the West, the requirements being for sheep that will yield a profitable clip of wool, produce good mutton lambs, and stand flocking in large numbers. It is believed possible to combine these characteristics in one breed, and with this idea in mind an experiment was begun in the fall of 1906 in cooperation with the Wyoming Experiment Station. Eighty-nine ewes and four rams have been purchased for foundation stock.

BREEDING MILKING SHORTHORNS.

Experiments in developing a milking strain of Shorthorn cattle have been begun in cooperation with the Minnesota Experiment Station and with nine Minnesota breeders, the latter having agreed to allow their herds to be used and to manage them according to instructions of the Department and the station.

BEEF PRODUCTION IN THE SOUTH.

Experiments in steer feeding under southern conditions have been conducted for the past three years in cooperation with the Alabama Experiment Station, and another experiment in the Tennessee valley (northern Alabama) is now in progress. The object of these experiments is to show what can be done under farming conditions in the way of improving the native cattle for beef purposes by means of proper feeds and the use of pure-bred bulls, and to make southern farmers familiar with the use of their by-products for meat production.

POULTRY BREEDING AND FEEDING.

The poultry investigations in cooperation with the Maine Experiment Station are being continued, the objects being to increase egg production and to compare the yields and welfare of hens when kept in flocks and inclosures of different sizes. From year to year the better laying hens are selected by their records in trap nests and mated with the sons of heavy layers. The results have shown that by the methods used hens with greater laying capacity can be obtained.

A poultry-feeding experiment was begun in the fall of 1906 at the Bureau quarantine station at Halethorp, Md., to determine the respective values of the moist mash, dry mash, and hopper methods of feeding. Further experiments will be conducted at the Bureau Experiment Station near Washington, D. C., which is a more favorable location and where a suitable equipment is now being built.

ANIMAL NUTRITION.

The experiments in animal nutrition with the respiration calorimeter, in cooperation with the Pennsylvania Experiment Station, during the fiscal year have consisted of a continuance of the investi-

gations concerning the influence of age and individuality upon the metabolism of cattle, and eight additional experiments, together with a number of check tests to control the accuracy of the apparatus. A bulletin upon the energy value of red-clover hay has been prepared for publication.

At the beginning of the new fiscal year, July 1, 1907, the work in animal nutrition was materially enlarged by the addition of cooperative experiments in feeding beef cattle at the Missouri Experiment Station. A large number of steers are being fed to compare the results of feeding 2-year-olds and calves, and exhaustive investigations are planned in the feeding of steers from birth to maturity. Representatives of different lots and ages, with supplies of the feed used at the Missouri Experiment Station, will be sent to the Pennsylvania Experiment Station for tests in the respiration calorimeter.

CLASSIFICATION FOR AMERICAN CARRIAGE HORSES.

The Bureau of Animal Industry has been instrumental, by means of a cooperative arrangement with the American Association of Trotting Horse Breeders, in preparing a uniform classification for American carriage horses. The adoption of this classification at State fairs and similar gatherings is expected to aid materially in fixing a uniform type of horse and to enable the farmer to appreciate more the value of the horses raised by him and thus secure some of the large profits made by middlemen, who now buy cheaply from the farmers and after a few months of handling and finishing often sell at fancy prices.

WORK RELATING TO THE DAIRY INDUSTRY.

A large amount of work, both educational and research, has been accomplished in the Dairy Division of the Bureau of Animal Industry during the year.

SOUTHERN DAIRYING.

Considerable effort has been expended toward improving the dairy conditions of the South under a special appropriation made by Congress for this purpose. Nine men have been engaged in the work in seven States. The work has enlisted the attention and good will of the farmers. Assistance has been rendered in the remodeling of old barns and the building of new ones, the construction of silos, the selection and breeding of herds, and the keeping of records of feeds and of the products of the dairy herds. Local market conditions and the sources of the supplies that are brought into the South from outside territory have been investigated.

Many farmers have been induced to keep records of their herds, so as to show the cost of feed and the amount realized from the products both before and while carrying out the suggestions made for

improved methods. Such records have been kept for 70 herds, comprising 1,606 cows. The results from 16 herds have been compiled for illustration and show an average increase of $3.75 in the monthly production of each cow. This is a striking example of the practical results to be obtained by the adoption of better dairy methods in the South.

The work has met with uniform favor. So encouraging have been the results of the Department's work that similar work is being taken up by some of the States. It is believed that after this special educational work has been well started the Department should withdraw and the States should continue it.

BUTTER INVESTIGATIONS.

Investigations to determine the cause of fishy flavor in butter are being continued and progress has been made, but a complete solution has not yet been reached. This trouble is the cause of heavy loss to the trade.

Experiments have also been made concerning the amount of acidity in cream and its effect upon the keeping quality of butter. Several thousand pounds of butter were made from cream having various degrees of acidity and the butter was stored at different temperatures to test its keeping qualities. It was found that pasteurized cream, churned sweet without starter, produced remarkably fine butter that kept without deterioration for weeks after it was taken out of storage. This was at such marked variance with the general views of butter makers that it has been deemed best to repeat the experiments during the coming year. If the findings of the past year are confirmed, almost a complete revolution in the methods of making butter from sweet cream seems likely to occur.

During the year an extremely simple and rapid method of determining the amount of moisture in butter and other products—a great need of the butter makers—was worked out by the Dairy Division. Application for patent has been made in such a way that the apparatus and method may be used by any person in the United States without payment of royalty.

LABORATORIES AT ALBERT LEA, MINN.

In the spring of 1907 laboratories for butter and cheese investigations were established at Albert Lea, Minn., in cooperation with the Minnesota Experiment Station. Bacteriological and chemical laboratories have been built and equipped, and arrangements have been made for a large supply of milk to be used for experimental purposes.

CHEESE INVESTIGATIONS.

The cheese investigations consist of three general lines, namely, soft-cheese experiments in cooperation with the Storrs (Conn.) Experiment Station, Cheddar cheese investigations in cooperation with

the Wisconsin Experiment Station, and Swiss cheese investigations at Albert Lea, Minn. The work on the Camembert type of cheese, which has been in progress for the last few years, has been practically completed, and a bulletin giving directions for making this kind of cheese was published during the year. At present a study is being made of the problems involved in the manufacture of Roquefort cheese. These experiments are intended to avoid the necessity of importing European cheese, as we have cheaper grasses and mill feeds than any other country.

IMPROVEMENT OF THE MILK SUPPLY.

Following the success of the milk and cream competitive exhibition in connection with the National Dairy Show at Chicago in 1906, similar contests have been held in other cities and have had a marked effect in the improvement of the milk supply.

A feature of the year's work was the investigation of the milk supply of Washington, D. C. Nine hundred and sixteen dairies and dairy herds, with 16,446 cows, were inspected and rated in accordance with a score card prepared by the Dairy Division. With few exceptions the conditions found were very unsatisfactory, the average score being only 45 out of a possible 100. This result may be considered as giving some indication of the quality and condition of the milk supply of the country, as it is believed that the conditions around Washington are no worse than those existing around other large cities.

The Department is taking an important part in the general movement for a better milk supply, and assistance in that direction has been rendered to a number of cities. Insanitary conditions of milk production and the prevalence of tuberculosis in dairy herds are two evils that should be overcome. Dairy products, which form a large part of our food supply, need special attention in order to insure wholesomeness. Is it the desire of Congress to supplement existing legislation by giving the Department authority to inspect all dairy cows and dairy establishments whose products are to enter interstate or foreign commerce, so as to exclude products of diseased cows and products prepared under insanitary conditions, according to the principle on which the meat inspection is based?

CREAMERY INVESTIGATIONS.

The economic features of the creamery business have received special attention during the past year. Reports were solicited from creameries with a view to giving them assistance in their methods of conducting the business. At the close of the year from 500 to 600 creameries were reporting monthly. A careful analysis of these reports shows a heavy loss to many creameries and to the farmers supplying them, owing to lax methods and the absence of system in keep-

ing records. These losses are computed to be not less than $5,000,000 a year for the entire country. Whenever reports indicating defective work are received, letters are written pointing out the defects and suggesting remedies.

The market inspection of butter at Chicago and New York has been continued with a view to assisting creameries to improve the quality of their product. Large quantities of butter deficient in quality are found in these markets. When requested by the shipper, the experts of the Dairy Division examine a shipment on its arrival at market and send to him promptly a reliable report as to its condition and quality. If the butter is not of good quality, they state what the defects are and make suggestions for overcoming the trouble. This work has resulted in a general improvement in the quality of the butter received on the market and has thus enabled the creameries to obtain better prices.

OTHER DAIRY WORK.

Farmers and dairymen are being encouraged to keep records of their dairy herds. It is believed that if this practice were more generally adopted much pecuniary and other benefit would accrue to the owners of dairy cows.

The work of planning dairy buildings of various kinds has been continued. During the year 56 different plans have been drawn and 504 blueprints made and sent out.

A thorough and prolonged study of the problems connected with the secretion of milk has been undertaken in cooperation with the Missouri Experiment Station. Other work includes a study of pasteurization and other processes which may affect milk from a bacteriological and chemical standpoint.

The Dairy Division installed and conducted at the Jamestown Exposition what was termed a modern dairy plant, showing the equipment and methods for a small dairy farm and for a large city milk business. Literature was distributed and stereopticon lectures were given.

RENOVATED BUTTER INSPECTION.

The Dairy Division carries out the provisions of the law of 1902 respecting the inspection of renovated butter, also known as "process" butter. There was produced during the year 63,000,000 pounds of this product, at 49 factories. This production represents an increase of 15 per cent over the previous year.

BUREAU OF PLANT INDUSTRY.

The work of the Bureau of Plant Industry covers a wide field. The Bureau is striving to aid the farmer in protecting his crops from destructive diseases; it points out ways of improving crops by breeding and selection, as well as by better methods of tillage and better

methods of management; it explores the world for new crops, and when these are found and introduced, it encourages and supports the efforts made in their production until new industries are established. The principal results secured during the year along these and other lines are briefly set forth under the following headings.

THE WORK OF THE PATHOLOGISTS.

During the year the pathologists of the Bureau have been called upon to undertake a number of new investigations and to continue important lines of work already under way.

Eradication of pear blight.—It was pointed out in my last report how important work had been inaugurated on the Pacific coast with a view to preventing the destruction of the extensive pear orchards, valued at many millions of dollars. Pear blight has been and is devastating these orchards, and the Department, in cooperation with State authorities, has been working to check it. The systematic work undertaken in the matter of eradicating blight from the orchards through winter pruning has led to beneficial results. The progressive orchardists who have carried on the work thoroughly have succeeded in holding the disease in check and in securing a profitable crop of fruit from the treated orchards. In other cases, however, principally as the result of careless treatment or no treatment at all, many orchards have been destroyed. The work will be continued this coming season and every assistance possible given to those orchardists desirous of fighting the disease. As already indicated, the Department has had the hearty cooperation of the State experiment stations and other State authorities, who are fully alive to the importance and necessity of doing all within their power to aid the fruit growers of the respective States in which they are located.

Control of apple diseases.—Another line of work which has been carried on successfully during the past year has had for its object the control of apple diseases in the Ozark Mountain region. This section of the country is developing into a fine fruit region, and the value of the orchards is increasing yearly. Since the orchards have come into bearing, however, various serious diseases have appeared, and the vital question of how best to control these diseases has arisen. Some of the work started last year in Nebraska and localities in Missouri had to be discontinued on account of the destruction of the fruit by cold. In a considerable portion of the Ozark region, however, there was a good crop of fruit not injured by cold, and in these orchards the control of bitter rot, black rot, and the fruit blotch was again practically complete where the methods recommended by the Department were carried out, from 95 to 98 per cent being saved in the sprayed orchards. In all this work combination treatments have been made

in order to prevent both diseases caused by fungi and injuries produced by insects. In this work the Bureau of Plant Industry is cooperating with the Bureau of Entomology.

Prevention of foliage injury in spraying.—For a number of years it has been a problem with pathologists to find some successful way of treating the peach with fungicides in order not to injure the foliage. Some of the standard fungicides often cause complete defoliation. For this reason it has been found difficult to control a number of serious diseases affecting the peach by any of the ordinary treatments. This year it was discovered that a sulphur wash made by combining lime and sulphur, with no other heat than that produced by the slaking of the lime, gave a preparation which was not injurious to peach foliage and which prevented the scab and reduced peach rot to 10 per cent on the sprayed trees, whereas unsprayed trees had 75 per cent of the disease. This fungicide, further, completely prevented the leaf-spot fungi and produced no injury whatever, either to foliage or fruit. While this preparation has been previously used in winter when the trees were dormant, this is the first time it has been tried on trees in active growth, with the success as indicated.

Control of California peach blight.—Last year mention was made in this report of a very serious disease of the peach in California, popularly known there as "peach blight." Experiments were conducted during last fall and winter for the control of this disease, and, as the result of this work, it was found that the disease could be completely controlled by the use of standard Bordeaux mixture or lime and sulphur wash applied early in the fall, about the time of the first rains. The methods recommended by the Department were widely used in California the past season with complete success, and we have been reliably informed that the treatment has meant many millions of dollars to the peach industry of that State.

Study of crown gall diseases.—The pathologists in this Department and in some of the experiment stations have for a number of years had under investigation a disease of fruits commonly known as "crown gall." Heretofore no organism has been definitely proved to be the cause of this disease. The results of the Department's work the past season indicate that there are two types of the malady. One form, which occurs in apples, producing hard galls, appears to be noncontagious, while the other, the soft gall, which occurs occasionally on apples and is the common form on stone fruits, especially the peach and plum, is very contagious. Two of our pathologists working on a similar disease in another plant have isolated an organism which produces galls practically identical with the soft crown gall on the peach, plum, hop, and numerous other plants. This is

an exceedingly important line of investigation and doubtless will pave the way for securing information which will be worth a great deal to the fruit interests of the country.

COOPERATIVE WORK ON FOREST DISEASES.—The great interest in all matters pertaining to the protection of our forests and forest trees has led to the further organization of work in the Bureau having for its object the special study of forest pathology. In order to carry out this work to the best advantage, cooperative arrangements have been made with the Forest Service to the end that the strictly pathological work is conducted by the Bureau of Plant Industry, while the practical application of laboratory discoveries is worked out and applied in the field by the forest experts.

NEW CROPS AND NEW INDUSTRIES.

The general policy of the Department, inaugurated several years ago, having for its object the development of home industries for the purpose of keeping money in the hands of our own people, has been followed during the year. Elsewhere in this report figures are given showing the immense amount of cash we still send abroad for things that we might grow at home. During the year experts of the Bureau of Plant Industry have been engaged in exploring foreign countries, securing new plants worthy of trial here.

ORIENTAL PLANT EXPLORATIONS.—China has proved a fruitful field for this work, and an explorer has been kept there constantly during the year. His work has taken him through the little-known regions of southern Siberia, the border of Manchuria, the excessively dry mountains west of Pekin, and through the fertile country between Pekin and Hankau. This explorer has sent to this country over a thousand living seed and plant specimens for trial. Among these are promising blackberries and currants from northern Korea; a north Manchurian apple; a collection of 24 named pears from north China; several bush cherries and plums and peaches from northern Siberia—perhaps the very northern limit of peach culture in the Orient; drought-resistant alfalfas; dry-land rices; staple foods of the native Manchurians, but unknown to us, from regions where the climate is similar to that of the Dakotas; and a cherry noted for remarkable earliness, ripening its fruit in mid-April in northern California. Besides these, the explorer has sent in a large number of ornamental plants which our nurserymen have been for some time anxious to secure, because of the unusual hardiness of these north China species.

NEW ALFALFAS AND CLOVERS.—During the year an explorer was sent out for the purpose of securing forage crops and was still abroad when my last report was submitted. He has returned with seeds

of the yellow-flowered Siberian alfalfa, and these seeds have grown into promising plants in the severe climate of the Northwest. The results of their trial will determine whether we shall import large quantities of the seed, as we have previously done with the Turkestan and Arabian alfalfas, both of which continue in their respective territories to gain in popularity. The Toten clover, secured from Norway, where it is cultivated for its extreme hardiness, is being tested in the Dakotas.

Two of the most interesting and promising introductions of the year were secured through the cooperation of the American minister at Pekin. Forty years ago a French missionary found alfalfa growing in the drier parts of Mongolia. In connection with the life-history studies being conducted by the Bureau, information was secured regarding this plant, the facts indicating that alfalfa was introduced into China about 120 B. C., and that it had been grown in the dry, cold regions of Mongolia ever since. Full information regarding this crop and one or two others was forwarded to our minister, and through his kindness small quantities of seed of alfalfa, a naked oat, and one or two other promising things were forwarded to us. The accounts sent by the missionaries who aided the minister make it seem very probable that the alfalfa is grown under dry-land conditions, and it is hoped the plant will prove a valuable addition to the collection of varieties now being studied in a scientific and practical way at various stations in the West.

New rice varieties.—For the rice growers of the South there have been introduced 46 varieties from different parts of the world, among them the One Hundred Day rices—early sorts, which, in Japan, give crops when ordinary rices fail.

Development of a mango industry.—The fruit growers of our tropical possessions have had their interest in mango growing stimulated by the fruiting of some of our East Indian fine-flavored varieties. All the local nurserymen are ready to sell in quantity several of the introductions of the Department, and not only are the experiment stations of Hawaii and Porto Rico taking up this fruit, but, what is especially important, private plantation owners are planting out orchards of our introduced sorts.

Bamboo introductions.—The growing scarcity of wood for manufacturing purposes has led the Bureau to make some extensive investigations of bamboo culture in Japan and other countries. Already a number of varieties have been introduced and steps have just been taken for the inauguration of a considerable number of plantations of these important plants in different parts of the South.

Encouraging the production of raw matting material.—Reference has been made in previous reports to the encouragement which is

being given to the matting industry of this country. The Department is anxious that we grow the raw material for the manufacture of this important product, of which we import five or six million dollars' worth annually. Our explorers have succeeded in securing an abundance of young stock of Oriental and Egyptian matting plants, kinds which are essential to the success of the industry here. Plantations of these are being established in a number of portions of the South in cooperation with influential men who are in earnest in regard to making this industry a profitable one, if it is practicable to do so.

LIFE-HISTORY STUDIES OF PLANTS.

Closely allied with the extensive work of plant introduction are the studies of the life history of crops and crop plants. This work has nothing to do with the mere testing of varieties. Life-history studies have for their object the securing of knowledge of the requirements and limiting factors of different varieties—knowledge which will tell us why one variety will succeed and why another may fail. The failure properly interpreted may give us an insight into the life history of the variety which will permit of its successful utilization under different conditions.

THE DATE PALM.—The plan with the date palm has been applied to a number of our new and promising industries. The date palm was one of the first to be studied in this way and its scientific life history investigated. The results of these investigations, published some four years ago, enabled the Department to predict with reasonable certainty not only those regions where date culture was promising, but the particular varieties most likely to succeed. These predictions have been the means of saving thousands of dollars which otherwise would have been lost through the attempted culture of choice late-ripening dates in localities where they could not possibly have succeeded. During the spring and summer of 1907 a new date garden was established at Indio, Cal. This garden is high enough above sea level to be free from danger of overflow from the Colorado River, which overflow at one time threatened to overwhelm the cooperative date garden at Mecca, Cal., some 10 miles to the eastward and 100 feet below sea level. A new date garden has also been established at Laredo, Tex., in a part of the Rio Grande Valley where the climate in spring and early summer is the hottest in the United States. It is believed that good dates can be grown in this part of Texas. The date palms in the Mecca garden, now from 2 to 3 years old, have begun to fruit freely, and the famous Deglet Noor and a number of other choice varieties have ripened perfectly, in spite of the fact that the season has been unusually cool. During the past year much interest has been taken in the planting of seedling date orchards in the hope of securing new varieties better adapted to American climatic

conditions. Altogether some 150,000 date seeds have been planted in cooperation with growers in California, Arizona, and Texas. These growers will receive one or two offshoots from imported date palms for every 250 date seedlings set out in proper form.

PERUVIAN ALFALFA.—As another feature of the life-history work to which reference has been made, the past season has brought to light a new variety of alfalfa from the high table-lands of the Andes which is even more distinct from the ordinary alfalfa than the promising new sorts introduced from Arabia. Ability to grow at lower temperatures than any other known alfalfa enables this Andean variety, the seed of which was obtained from Peru, to grow throughout the winter in some of our Southwestern States. This form passes without injury through frosts which kill all ordinary alfalfas, while it is almost completely winterkilled in all of the States from the Panhandle of Texas northward. This paradox is explained by the fact that its ability to grow at low temperatures and the autumn frosts which force other alfalfas into a dormant state do not cause this variety to cease growth and harden up its tissues.

HARDY CITRUS FRUITS.—Life-history studies are being applied also to questions concerning the further development of hardy citrus fruits. It has already been pointed out in previous reports how these hardy citrus fruits have been obtained by cross-breeding. In the spring of 1907 a large number of additional hybrids were made with a view to still further improve these types. In studying the life history of oranges a point has been developed which is of great importance in the matter of its hardiness. It is found that most oranges suffer from being forced into growth by warm spells of weather in winter; as soon as they have pushed into a tender growth they are injured by even a very mild degree of cold, which would be without effect on thoroughly dormant plants of the same variety. Studies now being made have for their object the securing of oranges which harden up their wood thoroughly in winter and are not easily forced into new and tender growth.

DROUGHT-RESISTANT OLIVES.—With the opening up of territory in the new Southwest heavy demands are being made upon the Department for information and light regarding the best crops for this extensive dry-land country. Southwestern Texas is a promising field, especially in the matter of arborescent crops. Investigations made in southern Tunis by an expert of the Bureau of Plant Industry have revealed the existence of extensive olive orchards in that region carried on where the annual rainfall is sometimes below 10 inches for several consecutive years and where the annual evaporation is over 100 inches. The olive grown under these extreme dry-land conditions has been imported and shows every promise of doing well in

some parts of Texas and Arizona. Steps are being taken to establish experimental orchards of these drought-resistant olives in a number of sections throughout this southwestern region.

WILD FRUITS OF VALUE AS GRAFTING STOCKS.—Studies made the past year in the Southwest have revealed the existence of a number of species closely allied to the almond and peach of the Old World. Several of these occur in very dry situations and one is distinctly of promise as a stock upon which to graft almonds, apricots, and other stone fruits for culture on unirrigated lands. Another species growing in central Texas bears a very early ripening fruit of fair size which is said to be of delicious flavor. Plants of this "wild peach" have been secured and selections will be made with the hope of obtaining a native drought-resistant peach-like fruit which can be grown in regions where peaches do not now succeed.

COOPERATION WITH THE INDIAN SERVICE.—In carrying out these plans of experimental and demonstration work in the southwest, the Bureau of Plant Industry has secured the cooperation of the Indian Service. A testing and demonstration farm has recently been established on the Pima Indian Reservation at Sacaton, Ariz. The Office of Indian Affairs, Department of the Interior, furnishes the land, water, and labor, and the Department of Agriculture plans the experiments and furnishes all the necessary seeds and plants. The Indian Service is well equipped with lands and well-trained superintendents, and their cooperation will make it practicable to carry on demonstrations with numerous dry-land crops, such as alfalfa, dates, figs, olives, etc.

PROGRESS WITH FORAGE CROPS.

In addition to the special work on forage crops connected with foreign introductions and life-history investigations, the Bureau of Plant Industry has a corps of efficient officers and men engaged in investigations having for their object the extension of important forage crops already here, especially alfalfa and grasses. This work also has for its object the improvement of important crops of this nature and the introduction of these improved types or strains whereever they are likely to prove of value.

EXTENSION OF CULTURE OF ALFALFA AND OTHER LEGUMES.—The introduction of leguminous crops throughout the different farming sections of the country is considered of the highest importance. The future maintenance of fertility is based on a wise use of such crops. During the year extensive work was carried on, having in view the extension of alfalfa culture into those portions of the country where it is not now a staple crop. About 500 carefully planned experiments were conducted with farmers the past season in cooperation with State experiment stations. In general, cooperators have shown much en-

thusiasm in these experiments and have spared neither time nor expense to make their work successful. The effect of successful work of this kind in stimulating neighboring farmers to undertake the culture of the crop is especially gratifying.

Encouragement of alfalfa seed production.—The great interest in alfalfa growing throughout the country has created a much larger demand for alfalfa seed than our farmers have been able to supply. This has brought about the heavy importation of foreign seed, some of which has been shipped even to the Pacific coast. With the enormous area devoted to alfalfa in this country we should be exporting seed rather than importing it. Investigations have shown that the yield of seed per acre is partly determined by the cultural methods used and is partly dependent upon varietal characteristics. Both these lines of investigation are being vigorously prosecuted so as to bring about a great increase in the production of American alfalfa seed.

Large yield of Arabian alfalfa.—One of the most promising alfalfas tested during the year is the Arabian type. At Mecca, Cal., this alfalfa has yielded twelve cuttings in the year as against eight cuttings for ordinary alfalfa. At Chico, Cal., seven cuttings of the Arabian were obtained as against five of the ordinary.

Possible identity of Grimm alfalfa with sand lucern.—It has also been observed during the year that the Grimm alfalfa, which is recognized as an important one in Minnesota and other regions where the winters are severe, is possibly identical with the so-called sand lucern cultivated in Germany and Bohemia. The Bureau has been making special efforts to extend the culture of the Grimm alfalfa throughout the cold regions of the upper Mississippi basin, but has been hampered in this effort by lack of seed. The sand lucern also has been found to be very hardy, and it is proposed to test it fully side by side with the acclimatized Grimm strain.

Improved timothies and other grasses.—A special effort was made during the year to enlarge the scope of the work on improving grasses. The rapidity with which such important grasses as timothy can be improved has already been pointed out. During the year two of the State experiment stations have also taken up this line of investigation. The seed of improved timothies described in previous reports has been distributed for experimental purposes with encouraging results. Work on other important grasses has also been undertaken. Brome-grass, orchard grass, redtop, and meadow fescue have received special attention in this direction.

Encouragement of cowpea culture.—One of the most important forage crops, for the South at least, is the cowpea. During the year extensive investigations have been made of this crop, the principal

object being to secure cheaper and better seed so as to bring about a great increase in cowpea culture. Special machinery has now been developed for harvesting the upright-growing varieties. The need is for good varieties producing small, hard seeds that will not crack and that retain their vitality for more than one year. Many new varieties have been secured from foreign countries and a large number of others developed by hybridization, some of which show great promise. The cowpea is to the South what clover is to the North, and the lessening of the cost of the seed and the improvement of varieties are the two important problems that need to be thoroughly pushed.

EXTENSION OF SORGHUM CULTURE.—The various varieties of sorghum have been receiving special attention with a view to their utilization, especially in the South, where the rainfall is more or less deficient. A large amount of seed of improved and pure-bred strains will be available for distribution in 1908. Among the numerous new introductions that are of great promise are two from Natal, one a black-hulled Kafir, having large elongated heads, the other a new type called Pink Kafir, characterized by rather large pink seeds and dense heads. A new sweet sorghum of unknown origin was discovered under cultivation in a single locality in Texas. It is the sweetest variety yet tested and will be disseminated under the name of Honey Sorgo. All these sorghums are proving valuable not only for forage but for grain throughout the Southwest, and their wider introduction is of considerable importance.

SOY BEANS FOR ROTATION ON RICE LANDS.—The rice growers of the South, especially in Louisiana and Texas, have long felt the need of a legume that might be grown in rotation on their rice lands. The Department has been successful in introducing a specially adapted variety of soy bean used on the rice lands of central China. These soy beans have been tested and give every promise of filling the need perfectly. Three varieties have been secured, all very similar and characterized by great leafiness, fine stems, and large size, becoming 6 feet high, so that they produce large crops of excellent hay. Thus we have a combination of crops which will, we hope, do for the rice grower what clover does for the wheat fields of the North, serving not only as a valuable soil improver but an important forage crop as well.

DISCOVERY OF AN EARLY-MATURING VETCH.—Other important investigations with forage crops have had to do with the introduction and encouragement of the growing of vetches throughout the South. The vetch is an exceedingly important plant and its much wider use is greatly to be desired. The principal difficulty in securing an extended use of these important plants has been the fact that they can not be harvested in time for cotton planting. The recent dis-

covery of a valuable new vetch which matures as early as the so-called native vetch of the South and which produces very satisfactory crops will, it is believed, obviate this difficulty and result in its extensive employment. Seed will be available for distribution and trial next season.

IMPROVING THE CORN, COTTON, TOBACCO, AND OTHER CROPS.

The special work of the Bureau in the improvement of plants by breeding and selection has been pushed forward during the year with vigor.

Breeding better strains of corn.—Extensive cooperative investigations have been carried on in the matter of corn improvement. Breeding for greater yields, improvement in forage, improvement in sweet corn, and other lines of work have been carried on in cooperation with several experiment stations and with a great many individual farmers throughout the country. Demonstration plots of corn in considerable areas have proved the most successful way of interesting the farmers in this important work. These farmers after a time supply greatly improved seed, thus advancing the work throughout an entire neighborhood.

Method of separating cotton seed.—In the cotton improvement work the introduction of practical methods of seed selection has enabled the cotton growers to get rid of light, inferior seed, and as the result of this work, which has aroused great interest, the yield has been increased from 10 to 15 per cent. The apparatus devised for the purpose of separating the seed has been improved so that it is possible to separate cotton seed into heavy and light seed at a very small cost.

Breeding cottons to escape weevil injury.—Improved and early varieties of cotton are being secured for growing in the boll-weevil districts. Seed of these varieties will be extensively distributed the coming season to the growers for testing purposes. The work of breeding improved varieties of cotton adapted to different conditions in various parts of the South has been continued and further work along this line inaugurated. Extensive selection of the best plants in the cotton fields has been made. Many new hybrids and various crosses have been tested and some promising results obtained. The principles worked out at the Texas Agricultural Experiment Station, in cooperation with this Department, for the purpose of securing cottons of early maturity, were briefly described in my last report. These principles were applied this year by a large number of farmers, with the result of great increases in productiveness for the selected sorts as compared with the unselected. This work has been carried on in the heart of the boll-weevil region, and, we believe, is so far advanced now that it may be discontinued, as the farmers themselves

can well continue it. The results, in brief, mean that every farmer has it within his power to breed productive strains which will so mature their cotton as to give yields exceeding those of old varieties and at the same time in such a way that the injury from the boll weevil will be largely minimized.

Insuring a stand of early planted cotton.—In connection with this work some important investigations have been conducted with the object of insuring a stand of early planted cotton. One of the greatest difficulties in early planting is rotting of the seed or the death of the young plant as a result of unfavorable weather conditions and methods of planting. The ordinary depth of planting ranges from 1 to 2 inches, usually upon a soft seed bed. The result of planting at this depth, and the condition of the seed bed under unfavorable weather conditions, is that the seed rots or the plant is exhausted before it gets through the ground. It has been demonstrated the past year that very shallow planting upon a firm seed bed that is so shallow as to scarcely cover the seed produces plants that make a good strong root, that do not exhaust their energies in getting through the ground, and that are less subject to damping-off and will make a good stand of cotton, even though the weather conditions are extremely unfavorable. The result of this work is believed to be of fully as great importance as the use of early maturing varieties in securing a profitable early crop. The principal shortage in the cotton crop in some localities this year is due more to the failure to get a stand of the early planted cotton than to any other cause. Demonstration work has proved conclusively that good stands could be obtained by shallow planting methods, despite unfavorable weather conditions.

Acclimatization of Egyptian cottons.—Numerous attempts have been made to grow Egyptian cottons in this country. During the year gratifying progress has been made in this work, Egyptian cotton of the Mit Afifi variety having been grown quite successfully under irrigation at Yuma, Ariz. One selection has yielded at the rate of 500 pounds of lint per acre, which is unusually high for Egyptian cotton in this country. Some of the improved Upland strains have also given equal and even superior yields in this region. The Upland varieties that seem at present most promising for this important agricultural section of the Southwest are the Southern Hope, Sunflower, and Columbia, the latter being a variety improved by the Department in South Carolina.

Breeding improved tobaccos.—All tobacco work of the Department was, in accordance with the action of Congress, taken up by the Bureau of Plant Industry the first of last July. One of the most important results of the past season's investigations has been the

introduction of the new varieties of tobacco which the Department has originated. The Brewer and the Cooley tobaccos have given increased yields of a better grade of cigar-wrapper tobacco than the unimproved varieties, and in those sections where they have been tested many of the large and successful growers are planning to use these varieties exclusively next season as the result of the favorable experience of the past year. The new and improved types of Sumatra varieties of cigar-wrapper tobacco are being adopted by growers in Florida and the Connecticut Valley for growing under shade. They rank among the best varieties of cigar-wrapper tobacco now grown. Other new varieties are being tested in the various sections of the tobacco-growing States, some of which have been found to be valuable. A nematode-resistant type of cigar-wrapper tobacco has been produced in Florida. In view of the great annual loss sustained by southern tobacco growers from this injury, the production of a resistant variety is of the greatest importance to the growers. Considerable quantities of seed of the various new varieties of tobacco will be distributed to interested growers this winter for use next season. The demand for such seed in sections where the tobaccos are grown is already beyond the quantities available for distribution. However, sufficient seed has been saved to give to the growers a limited supply, consistent with the introduction of new and improved varieties.

Improvements in handling the tobacco crop.—Improved practical methods of seed selection and seed separation for tobacco have been discovered by experiments and are proving to be of benefit and practical value to all tobacco growers. At the various experimental fields where the tobacco work of the Department is being carried on thousands of farmers have visited the places and have secured from observation the benefit derived from this work. Improved methods of preventing damage from pole burn in the curing sheds have been devised as a result of experiments carried on in different parts of the country the past season. Extensive laboratory work has also been carried on in the matter of the nicotine content of tobacco. The demonstration work in various parts of the regions where the different tobacco types are grown has been continued, with encouraging results.

Breeding disease-resistant asparagus and other crops.—Aside from the foregoing a number of general problems in breeding have been under investigation. The question of securing rust-resistant varieties of asparagus has been given special attention during the year. The rust disease of asparagus is threatening this industry in a number of sections and the efforts being made are for the purpose of securing types which will be resistant or immune to the disease. The

Bureau of Plant Industry is cooperating with the Massachusetts Experiment Station in these investigations.

Work in the breeding of wilt-resistant melons was practically completed during the year. The new wilt-resistant hybrid melon, to which attention was called in my last report, was grown on a commercial scale during the past season and easily held its own in the market with the varieties of its class. It produced an excellent crop on land where ordinary melons were destroyed by wilt. In connection with the breeding of wilt-resistant cotton further tests have been carried on with Upland cottons. Some of these Upland wilt-resistant types have not only proved valuable from the character of their lint but also from the quantity of fiber produced. Considerable work has also been carried on in the matter of breeding alkali-resistant and drought-resistant plants. This work has included such crops as cereals, forage crops, grasses, and sugar beets.

WORK IN THE IMPROVEMENT AND EXTENSION OF GRAIN CROPS.

This important line of investigation has been continued in much the same way as touched upon in my previous reports.

DURUM WHEAT.—Efforts to still further extend the durum wheats have continued. The successful production and utilization of this wheat continue, notwithstanding the numerous unfavorable comments and predictions made in reference to it since its introduction seven years ago. Twenty million bushels of last year's crop were exported to Europe. Of the remainder all except a seed reserve went rapidly into domestic consumption, chiefly for bread flour. It is certain, from official figures, that over 6 million bushels were ground in Minneapolis mills. Probably 10 million bushels were used in the country mills of the Northwest. In Minneapolis a large portion of this wheat was blended with Hard Spring, although a considerable amount of straight semolina was made for macaroni factories. In the country mills a considerable quantity of pure durum wheat flour was made.

The 1907 crop of durum wheat in the Northwest is probably about the same as that of last year. It is difficult to follow its extension everywhere. The acreage in the Middle West and Southwest is now, however, becoming important, and the production in those areas this year is probably about 5 million bushels. There is now also a considerable acreage in Montana, Idaho, Oregon, and Washington. Of this new crop over 8 million bushels have been exported to November 1. An important feature of recent shipments is that large amounts are going to northern Europe for bread flour. One-fourth of the entire export is being used in Great Britain. Recently durum wheat was preferred in Antwerp over No. 2 Red Winter, the latter selling at 2 or 3 cents less per bushel. A dozen or more cars per day are at this time being received in Chicago, all of which is sold to domestic mills.

Statements recently made that durum wheat is deteriorating are found, after investigation, to be incorrect. Samples from certain localities, particularly in the Red River Valley, where it should not be grown, have a large proportion of white, soft grains, but the larger part of the present crop is of good quality.

EXTENDING THE WINTER-GRAIN AREA.—The Bureau has made a special effort during the year in the continuation of the work of extending the winter-grain area in the Middle West and the North Central States. Grain-growing conditions in these sections have been greatly improved through the introduction by this Department of winter hardy varieties adapted for autumn seeding, the testing and distribution being accomplished in cooperation with the State experiment stations. Tennessee winter barley is now fairly well known throughout Kansas, and is giving from 30 to 50 per cent better yields than spring barley every year. The use of Kharkof wheat has virtually established winter-wheat production over considerable portions of Nebraska, Iowa, and South Dakota.

INTRODUCTION OF EMMER.—Emmer, the grain about which the Department has already published some information, is being more and more recognized as a good stock food and is found well adapted to the dry-land areas. More recently the Department has successfully established a winter hardy variety, which, in addition to the qualities of the ordinary spring-sown emmer, furnishes good fall pasturage.

MISCELLANEOUS GRAIN PROBLEMS.—As agriculture gradually extends into our western sections demands come for information relative to grains suitable for high altitudes. In response to these demands experiments with hardy varieties have been inaugurated at several points of high elevation. Tests of the most promising sorts have also been made under field conditions in cooperation with farmers. Hull-less barley, early oats, emmer, durum wheat, and spring rye are found to be particularly suitable for these districts. The important work on the study of grain diseases, investigations of rice and rice varieties in the South, and the improvement of grains have been continued.

SOIL BACTERIOLOGY.

The work in soil bacteriology has been extended during the past year to include the whole question of the relation of bacteria found in soils to fertility and crop production. Outside of the work of the Department and two of our experiment stations, very little has been done in this country on this general subject.

RELATION OF BACTERIA TO FERTILITY.—Though this work has not gone far enough yet to warrant any general statement of results, it has been shown that the failure of nodule bacteria in certain soils is due to the presence in the soils of certain bacteria antagonistic to the nodule form, and that if these antagonistic forms can be removed

leguminous crops can be grown and successfully inoculated on these soils. In other cases it has been found that certain soils otherwise in good condition lack effective nitrifying and ammonifying organisms, these soils being improved in fertility when these organisms were supplied.

Distribution of inoculating bacteria.—The distribution of bacteria for inoculating various legumes has been continued during the past year with increasing success. It has been found especially important to carefully examine soil conditions before inoculation, and a method of doing this quickly in the laboratory has been devised, based on the soil-solution work of the Bureau of Soils. Over 18,000 cultures have been distributed during the year, and, from the reports received to date, they have been used with success in the majority of cases.

STUDIES OF WATER CONTAMINATION.

In the water purification work principal attention has been given during the past year to the study of the conditions of water supplies, especially on dairy farms.

Improvement of farm water supplies.—The results of the work showed that the water supplies on a large percentage of dairy farms, especially in the vicinity of Washington, D. C., were in very poor condition, and as the work has extended it has been found that the condition is apparently as bad in other localities. This line of work is especially important, not only to dairy farms but to farms in general, and the Bureau of Plant Industry, cooperating with the Bureau of Animal Industry and the Public Health and Marine-Hospital Service, will do everything possible to improve these conditions.

Work in the Canal Zone.—A great deal has been done also in the treatment of reservoirs for algal pollution. Probably the most striking treatment was that carried out under the direction of the Department experts in the Panama Canal Zone, the work there being highly successful and satisfactory to the canal authorities.

FRUIT INVESTIGATIONS.

Investigations of the marketing, transportation, and storage of fruits have been continued along the lines mentioned in my last report. The grape work and fruit district investigations have also been continued.

Methods of marketing apples.—Particular attention has been given to methods of packing and handling winter apples. Investigation of foreign shipments of these apples indicates that more than 20 per cent of such shipments are classed as "slack," caused by insufficient shaking of the barrels in packing, insufficient filling of the barrels, over-ripeness at harvest, and careless and rough handling.

Improvement in handling and shipping oranges.—Investigations of the causes of decay in oranges from California were continued. Practical demonstrations and trial shipments have shown the results of different methods of packing, handling, and shipping upon the keeping quality of the oranges. This work continues to have the support of all those interested in the citrus fruit industry, and the methods of handling the crop are being changed in many respects. Reliable authorities have estimated that the improvements already effected have resulted in an annual saving to the industry of from one-half million to one million dollars. Preliminary investigations have been begun to determine the causes of losses in Florida oranges, and it has been demonstrated, as in California, that the rough mechanical handling of the fruit is one of the principal causes of the trouble.

Progress in grape investigations.—In connection with the grape investigations, additional resistant varieties have been planted at each of the cooperative vineyards in California, and the work is progressing satisfactorily.

SUGAR-BEET INVESTIGATIONS.

During the year investigations of sugar-beet growing have been continued along lines similar to those discussed in previous reports.

Production of American-grown beet seed.—The development and improvement of American strains of sugar-beet seeds have been continued. This work is carried on in a number of States and the results have already been very encouraging. Large quantities of American-grown seed have been distributed to farmers, and cooperative experiments were inaugurated whereby it was made practicable to test the seed grown in this country alongside of the best European seed. In all cases the American seed has been found equal to and, in a number of instances, superior to the foreign-grown product.

Results of the year's work.—The special investigations pointed out in previous reports in the matter of breeding beets of high sugar content have been carried on mainly in the State of Washington. The studies on the development of single-germ beet seed have also been continued with encouraging results as to progress. We now have these beets giving progeny of high sugar content and yielding 50 per cent of seed of single germs. During the year a number of diseases of the sugar beet have been investigated and further work has been carried on in the matter of testing fertilizers for the purpose of increasing the tonnage. Some investigations have also been inaugurated in the matter of handling the beets, rotation of crops, and other subjects of a similar nature.

From the latest information it would appear that the sugar production of the country for the year just closing will amount to

approximately 500,000 short tons. Our representative reports that crop results throughout the sugar belt are checking out very closely those of last season. There will be three or four more factories in operation than last year. Two or three factories new last year will work a larger tonnage this season. The tonnage of sugar will in all probability approximate from 20,000 to 30,000 more this year than last. The crop in Colorado is from all appearances a little heavier than that of last year. In California it is a little lighter. In Wisconsin and Michigan the crop is fairly good and about the same as that of last season. Colorado will come close to 200,000 tons of sugar. Altogether the industry is in a prosperous state.

STUDIES OF POISONOUS PLANTS.

Investigations of plants poisonous to stock have been continued during the year with encouraging results. The causes of a number of serious outbreaks of stock poisoning have been investigated and remedies prescribed. Some important results have been obtained during the year in the matter of loco poisoning, its cause and remedies.

Cooperation with the Forest Service.—In connection with the work of the Forest Service important questions have arisen regarding injury to stock through the eating of poisonous plants. The Bureau of Plant Industry has entered into cooperation with the Forest Service, whereby examinations of this nature will be made with a view to taking steps for the prevention of losses in the future.

THE GROWING OF DRUG CROPS AS A NEW INDUSTRY.

It has been pointed out in previous reports that from 10 to 15 million dollars are sent abroad each year for the purchase of drug crops, many of which could be grown here. With a view to determining the conditions of soil and climate where these drug crops will grow to the best advantage, experimental work has been under way for some time.

Establishment of the camphor industry.—Drug gardens are now established at a number of points, and as a result of this work it is believed that the camphor industry has been established on a firm basis. A large acreage is being planted to camphor in Florida, and interest in the growing of this crop is shown elsewhere. From 3,000 to 4,000 acres of the trees are being prepared for planting in Florida alone.

PROGRESS IN SEED STUDIES.

The Department is making a special effort to educate the farmer in the matter of good seeds. With this end in view many thousands of tests have been made during the year, both for seedsmen and for farmers.

DECREASE IN PRACTICE OF SEED ADULTERATION.—The work on seed adulteration has been continued with gratifying results. Aside from the continued sale of Canada bluegrass seed for Kentucky bluegrass seed, fewer cases of adulteration have been found than in former years. The importation of low-grade red-clover seed has continued, some lots containing over 8,000,000 weed seeds per bushel.

INVESTIGATION OF DODDER INJURY.—During the year special attention has been given to the loss caused by dodder infesting clover and alfalfa. Dodder has proved such a serious pest the past year throughout the world that the International Seed Control Congress at Hamburg, in September, 1906, took action toward encouraging all governments represented to adopt measures for the extermination of this pest.

CONGRESSIONAL SEED DISTRIBUTION.

The work of securing, packeting, assembling, and mailing the seed for Congressional purposes was carried on the same as in past years. This work is now so systematized that it goes along smoothly, despite the large quantities of seed that must be secured and sent out. The total number of packages put up and distributed has remained the same for the past six years. In the annual distribution 6,400,000 packages of miscellaneous vegetable seed are put up and sent out, each package containing 5 packets, and 800,000 packages of flower seed are put up and distributed in the same way, each package containing 5 packets.

EXPERIMENTAL GARDENS AND GROUNDS AND ARLINGTON FARM.

The Department grounds have been further improved during the year by the addition of a large number of new shrubs and trees and by repairs to the greenhouses and fences. A new greenhouse has been constructed during the year, which is a model of its kind. Over 90,000 plants of many varieties were propagated and distributed, and the important hybridization work which the Bureau is carrying on was continued with satisfactory results.

WORK OF THE ARLINGTON FARM.—Many problems of a general nature connected with crop growth and crop conditions are being worked out at the Arlington Experimental Farm. The Forest Service, the Bureau of Entomology, and the Bureau of Soils have each been allotted certain areas for working out problems pertaining to their respective investigations. The greater portion of the farm, however, is used for the various lines of work conducted by the Bureau of Plant Industry. The drug garden has been successfully established, the peach orchard has now begun to bear, a small cranberry bog has been established, and extensive tests with beets and radishes have been conducted at the testing gardens. The condition

of the soil on the farm has been greatly improved during the year. Two additional greenhouses have been constructed and other improvements have been made.

HELPING THE FARMERS IN THE BOLL-WEEVIL REGION.

The Bureau of Plant Industry has been engaged for the last three or four years in encouraging the diversification of crops, the improvement of systems of farm management, and the handling of farms in the sections invaded by the boll weevil and those in which it would seem that the boll weevil is likely soon to appear. This general propaganda work has been under the supervision of a representative of the Department, with headquarters at Lake Charles, La., and has met with great and continued success. The object of the work is simply to bring to the attention of the farmer plain and practical methods of bettering his condition, improving his soil, and growing larger crops. Diversification is taught as far as it can be taught under existing circumstances. The people are reached largely by personal contact with representatives of the Department. Close touch is kept with all those who are working in order to determine definitely the difference in actual money returns from farms or portions of farms handled by the old methods and on the newer plans. During the past year the Department cooperated in this way directly and indirectly with more than 100,000 farmers in the more important cotton States.

GRAIN STANDARDIZATION.

Attention was called in my last report to the unsatisfactory methods of handling and grading grain now in vogue. The laboratories established at Baltimore and New Orleans have continued to receive the cordial cooperation of all interested in the handling of grain and have determined some of the more important factors entering into the question of standardizing present methods and grades.

Development of moisture-testing apparatus.—The moisture-testing apparatus introduced last year by the Department has been used with great success in these laboratories. This apparatus has been adopted by many commercial organizations, and they report that it has been of the greatest value to them in determining the moisture content of grain. This apparatus enables us to determine the moisture quickly and accurately, making it entirely practicable for use under commercial conditions.

Establishment of new laboratories.—Additional laboratories have been established at Duluth, Minneapolis, St. Louis, and New York. At Duluth and Minneapolis special attention is to be given to finding the best method of accurately determining and measuring dockage. Through the work of these laboratories and the general

investigation of grain-trade conditions the Department is coming into possession of much valuable information which should enable it to be of great assistance in straightening out the unsatisfactory conditions now existing.

NEED OF UNIFORMITY IN INSPECTING AND GRADING GRAIN.—It becomes more and more evident as this work progresses that some uniform system of inspecting and grading grain is absolutely imperative. Our producers of grain suffer through the lack of uniformity in grading, and our markets abroad are injured by lack of confidence in the grades established. It is believed that the end to be attained is through National inspection of all grain entering into interstate and foreign commerce, and the attention of Congress is respectfully called to this important question.

FARM MANAGEMENT.

Farm management investigations have been continued during the year along the lines set forth in previous reports. For the purpose of systematizing the work the country is divided into sections and the systems of successful farm management in these sections is being studied by experienced men.

CROPPING SYSTEMS FOR STOCK FARMS.—From data which have been thus secured the Bureau has been enabled to outline and plan cropping systems to meet the needs of those desiring specific information along these lines. During the year a simple method of planning cropping systems for stock farms has been developed and such systems have been worked out and applied to a number of farms in various parts of the country.

ENCOURAGEMENT OF DIVERSIFICATION OF CROPS.—In many sections of the country it is found that systems of farming have been developed based on a single crop. Frequently this crop is grown year after year on the same land and forms the sole basis of the farmer's income. Such systems are found in some of the wheat-growing areas of the Plains region and the Far West. In these sections the land is becoming infested with many bad weeds. In some parts of the corn belt corn has been grown continuously for sale until the land has become depleted and insect pests are gradually reducing the yield of corn. In the Southern States the continuous clean cultivation of cotton has destroyed the humus of the soil and yields are unsatisfactory. In all these instances the Department of Agriculture is working out systems of diversified farming which provide for the maintenance of fertility and render the farmer less dependent on the single source of income.

STUDIES OF METHODS ON SUCCESSFUL FARMS.—Realizing that preeminently successful farms have solved many of the most important

problems confronting farmers in this country, experts in farm management in this Department have continued the study of such farms with valuable results. The success which a few men have attained in farming has in no case been due simply to good judgment in buying and selling. In every case thus far studied success has been due not only to good business methods, but to the application of the teachings of science in crop production and in the care and management of stock. Farmers of this class are invariably well informed concerning scientific investigations relating to farming. During the year careful studies of several successful farms have been completed and the results have either been published by this Department or are now in course of preparation for publication.

VALUE OF THE PRICKLY PEAR AS STOCK FEED.—As a special investigation the Office of Farm Management has made a study of the prickly pear as a farm crop during the year. Conservative estimates based upon actual feeding tests and upon yields obtained from cultivated fields show that 1 acre of cultivated pear will furnish roughage for one cow the year round. An average production of nearly 23 tons of green feed per acre per annum has been grown upon the experimental grounds near San Antonio, Tex., during the past three years. The native growth has been used as stock feed for many years, but its cultivation was never attempted until three years ago. The response to cultivation has been remarkable, eight times as much forage being produced upon cultivated ground as upon uncultivated ground. When it is considered that the crop economizes labor, that a plantation is good indefinitely when once established, that it can be fed in a succulent condition every day of the year, that it is relished by nearly all farm stock, and that it is extremely resistant to drought, it is clear that this crop must become an important adjunct to the live-stock industry of the Southwest.

FOREST SERVICE.

RETURNS FROM THE NATIONAL FORESTS.

At the beginning of the fiscal year the area of the National Forests was less than 107,000,000 acres; at its close, more than 150,000,000 acres. Nearly all the timber land of the unappropriated public domain is now under actual administration by the Forest Service. This means that it is being protected against fire, theft, and wasteful exploitation, that its power to grow wood and store water is being safeguarded for all time, and that nevertheless its present supply of useful material is open to immediate use wherever it is wanted. The timber in the National Forests, which is the legacy of the growth of centuries, is now in the truest sense public property, administered for the benefit of the people—primarily for the benefit of the people

of the West, since they are nearest at hand, but on the whole for the benefit of every part of the country, since the welfare of every section is interwoven with that of all others. The communities and settlers adjacent to these forests are safe from any fear of monopoly of one of the chief necessities of civilized man.

The Government is not a landlord owner, but a trustee. As a trustee it must treat all alike and refuse permission to the first comer to pocket the share of all the rest. Hence timber is given away through free-use permits only in small quantities to the actual home maker, who comes to develop the country, and in larger quantities to communities for public purposes. Otherwise it is sold to the highest bidder, but under such restrictions as look to the maintenance of a lasting supply answering to the needs of the locality, to be had without favoritism and without extortionate demand based upon the necessity of the consumer.

Though the value of the forests as public property is not measured by what they turn into the Treasury of the Government, but by what they contribute to the welfare of the people in the States in which they lie, it is none the less a matter of striking importance that the receipts from them during the year totaled over $1,530,000, or almost exactly twice those of the previous year, and more than twenty times those of two years ago. The cost of their administration to the Government, including that part of the expenditures of the Forest Service in Washington properly chargeable under this head, were less than $1,500,000. In other words, the forests are already self-supporting, though they have been under the control of expert foresters less than three years. The total expenditures of the Forest Service for all purposes during the year was $1,825,319.50—considerably less than I estimate that the receipts from the Forests will be during the present year. As yet, however, from the standpoint of true economy the expenditure for the protection and improvement of these Forests is far too low. France spends annually upon state forests less than one-fiftieth the area of our own over $2,500,000 and realizes $4,230,000; Prussia spends upon 7,000,000 acres over $11,000,000 and realizes $17,054,144; Saxony spends upon only 400,000 acres over $900,000 and realizes $1,651,882. Yet in all these countries, unlike our own, the forests have had great sums spent upon them in the past in the form of permanent improvements, to which are largely due their present returns. A forest can no more be made to yield a constant return in valuable products without the investment of capital in improving the property than can a farm. If the United States spent as much per acre upon these forests as Prussia does upon hers, they would cost each year $250,000,000. If they brought in as much per acre, the gross revenue which they would yield would amount to $650,000,000, and the net revenue to

$400,000,000. The development of the wealth-producing possibilities of the National Forests—not, it must be insisted, in the narrow sense of income yield to the National Treasury, but in that of economic usefulness to the people—is hardly begun.

I have asked for an appropriation for the Forest Service during the fiscal year 1909 of $3,200,000. This, if all spent upon the National Forests, would amount to 2 cents per acre. France spends annually upon her state forests 95 cents per acre, Switzerland $1.32, Prussia $1.58, and Saxony $2.32. These are the countries in which the management of the forests is most profitable in products. The countries which spend most do so because their forests are brought to a high state of development. Thus utilizing their full productive powers, they derive from them a net profit which is very high. On the other hand, the countries like Sweden, Hungary, and India, which spend from 2 to 34 cents per acre, derive a very low revenue—in other words, a small volume of products—from their forests.

NATIONAL FORESTS NOT EXPERIMENTS.

It is worth remembering in this connection that these Forests have not been set aside, and the proposed expenditures are not to be made, in order to try a doubtful experiment. It is true that the practice of forestry has only lately begun to be applied to American conditions, but this is far from meaning that it is something new, untested, or of uncertain issue. It is as sure that forest land can be made to grow successive crops of trees under proper methods as that plow land can be made to grow successive crops of wheat; as sure that forests can be made to conserve the water supply as it is that manuring enriches the soil. As time passes, it will doubtless appear that the principles which centuries of experience in older countries have placed at our command can be applied with increasingly good results as we grow more familiar with our own special conditions; it may be that mistakes will be made in individual cases; but of broad success there can be no question. The issue is sharply between caring for our forests by applying a system of known efficiency, or suffering certain loss not only of the forests, but of usable water and soil as well, through the operation of causes as certain to act as are the rivers to run to the sea.

THE GAIN IN THE USE OF THE FORESTS.

The use of the National Forests by the people of the West is increasing at an extraordinary rate. The value of timber sales, the number of stock grazed, the demand for free-use and special-use permits all tell the same story. The Forests are more and more contributing to the material welfare of those in their vicinity. This is altogether as it should be. But it is out of the question to transact

twice as much business and protect a much larger area of Forests without a corresponding increase in the administrative and protective force. The demands imposed by the enlarging use of the Forests diminished to a very dangerous degree the attention that could be given to the work of patrol. The force upon National Forests must be increased as the business of these Forests increases.

SOME IMMEDIATE PROBLEMS.

Notwithstanding the fact that forestry is a thoroughly tested system by which other nations have met and solved the same difficulties which now confront us, the Forest Service has many novel problems to work out. For its task is not merely to save the Forests through use, but also to find out how to make the most of them. Scattered as they are throughout the West from Alaska to Arkansas and from Minnesota to California, they grow under climatic conditions that vary from almost subarctic cold to almost tropical heat, and from the heaviest rainfall of the continent to the extreme of aridity which tree growth can endure. Just as American farming has had to develop and is still developing methods adapted to the conditions of each region to make the best use of agricultural land, so must the forester learn by scientific study and practical trial to make the best use of our timber land. And the best use means, of course, not merely its best use for the growing of trees, but its best use with reference to all interests directly or indirectly affected by it.

Through records of the effects of all cuttings made, knowledge is being gathered which will make it possible constantly to improve upon the methods employed in harvesting the timber crop and replacing it by another. Two other problems under investigation which are of special importance are range improvement and forest extension.

Unlike the demand for timber, the demand for range in the National Forests is already large enough to employ practically the full productive capacity of the land. There were grazed last year on the Forests over 1,200,000 horses and cattle and 6,650,000 sheep and goats, representing a total investment of perhaps $44,000,000 and a probable annual profit, under the conditions of recent years, of $8,000,000. Upon the cattle industry of the western range depends to a large extent the farmer of the prairie States for the profitable marketing of his corn crop, the workingman of the East for his food supply, and our foreign trade for one of its important articles of export. The entire country, with its rapidly growing population, is therefore concerned in the power of the range to supply summer feed to the stockman. Under the conditions which obtained before the Forest Service undertook to regulate grazing, the carrying power of the range had seriously fallen off through overgrazing and competition. By putting a stop to these evils the Forest Service has not

only partially restored the range to its former carrying power, but has also given greater stability to the stockman's industry by recognizing his right to protection against newcomers, and made it possible for him to bring his stock through in better weight and condition. Nor is this all. An exhaustive study of the possibility of range improvement through artificial seeding, through changes in the present methods of handling stock to favor the growth of the best native forage plants, and through extermination of poisonous plants has been inaugurated. The whole problem of range control and improvement will be pursued until every part of the range in National Forests is producing the best crops of forage which the circumstances will allow.

Forest extension opens a field the importance of which can hardly be overestimated. The fires of past years and centuries have stripped great areas of western mountain timber land of all forest growth. The need of conserving the rainfall and snowfall of these areas makes reforesting a step of urgent necessity. At the same time it is often one of the utmost difficulty. In dry climates particularly (where the need is greatest), to establish a forest without prohibitive expense calls for the most careful study of methods and of the adaptability of different species to the conditions. Even after plantations are apparently well established a season of unusual drought may turn the scale against the growing trees. Millions of acres must be planted—and this means that thousands of millions of small trees must be raised—but there is yet much to be done before planting on a scale commensurate with the needs can be begun. This preliminary work is being pushed with as much energy as the funds available for the work will permit.

In a large part of the Northwest, at least, there is good reason to believe that broadcast sowing of seed may be practicable. If this proves to be the case, the way will be open for restoring to forest cheaply very much of the burned-over land. Hitherto the experimental sowings have shown surprisingly good results. The country's need of timber is certain to be so acute before many years that the work can not be entered upon too quickly. Broadcast sowing, however, to give good results, must probably be confined to heavy seed years, when a food supply for the animal life of the forests is abundant enough to prevent too great interference with the sowings.

NEED OF A CENSUS OF STANDING TIMBER.

That the United States is even now nearing a time of severe scarcity of lumber is no longer a matter of doubt. Each year makes a further heavy inroad upon the remnant of our virgin forests, and the growth of our abused and depleted forest lands for three years would not meet our needs for one. Under these grave conditions it becomes a matter of very practical and exigent importance to know with some degree of

accuracy how much standing timber we have. Many commercial organizations have, during the last few months, passed resolutions asking the Government to undertake a census of our sources of supply. The Bureau of the Census and the Forest Service are ready to act together to take such a census, if this is made possible by action of Congress, and I urge most strongly that the appropriation necessary for this purpose be made. Until it is known not only how fast our forests are being used, but also how much is in reserve and how fast new wood is growing, our measures to meet the crisis will be planned in ignorance of some of the essential facts.

WORK OF THE YEAR.

ADMINISTRATION.

The business efficiency of the Forest Service organization was put to an extraordinary test by the work of the year. Great credit is due the members of its administrative force for the energy, patience, and good sense with which they assumed greatly increased responsibilities and discharged trying duties. The increased volume of National Forest business imposed a severe strain upon the machinery of organization and the personnel. Special mention should be made of the work of the forest rangers, the rank and file, who form, so to speak, the firing line of the Service. Their pay is low—too low for the requirements placed upon them—their responsibility great, and their life one which makes necessary self-reliance, initiative, and good judgment. The conspicuous success which the Forest Service has achieved in making the Forests useful to the people of the West is due in no small measure to the fidelity of these true public servants, performed as a part of the day's work and without thought of other reward than their own consciousness of duty well discharged. I am glad to acknowledge the indebtedness of the Department to these men.

A noteworthy gain in efficiency of organization for the handling of National Forest business was secured along two exceedingly important lines—closer harmony between the Washington office and the field force and enlarged local responsibility for the supervisors. By the one the two parts of the Service have been drawn into closer touch with each other; by the other the Service has been brought into closer touch with the public. The first was effected by bringing supervisors into the work of the central office in rotation, usually for two or three months, to take charge of the Washington end of forest business. The second involved a substantial increase of the authority of supervisors. Supervisors are not machines for receiving instructions and carrying out the orders of a bureaucratic organization which decides important questions far from the scene and without regard for local conditions, but men in real charge of the business and technical

management of their Forests. They are held to rigid accountability for results, through systematic and searching inspection. Those who prove incapable of rising to the responsibility laid upon them are displaced. On the whole the ability shown by these forest officers has been a striking illustration of a characteristic American trait—the power to accept responsibility and rise to the situation as new duties and opportunities open.

IMPROVEMENT WORK ON NATIONAL FORESTS.

The special fund of $500,000 appropriated by Congress for permanent improvements on the National Forests is being well spent. Before this fund was made available the Forest Service was compelled to draw upon the sums at its disposal for the payment of current expenses, to provide whatever was spent in betterment of the Forests. Such expenditures were virtually reinvestments of a part of the income yielded by the Forests. Rangers' quarters, fences, fire lines, bridges, roads, trails, and telephone lines facilitate the transaction of business, the use of the Forests, the convenience of the public, and the protection and development of the property. The Forests were not created to be kept as wildernesses. They must be opened both to use and to habitation. In time they will increasingly be places for homes, industries, villages, and towns. The more they are made traversable and habitable the greater will be the development of their wealth-producing power. This work of development is as yet hardly well begun, for the size and capital value of the forests open a field of vast possibilities. That improvements do actually bring increased use the results of those already made leave no doubt. Provision should be immediately made for carrying on this work.

GRAZING.

Two years of trial have amply demonstrated the wisdom of the present method of range control. Since it is an essential part of that method that where the grazing privilege is sought for more stock than can be safely admitted some must be shut out, there is necessarily a certain amount of dissatisfaction among those to whom permits for a part or all of their stock are refused. Such dissatisfaction can not be allowed to weigh against what is manifestly the best interest of the community and the grazing industry itself. The only alternative, other than the old and ruinous one of permitting the range to be scrambled for by all alike, would be to grant the privilege to those willing to pay most for it. This would be a grave mistake. It is not in the public interest that the small owner who has established a home near the Forest should be crowded out by the big man, nor that those who have identified themselves with a locality should have to give way before the transient herd. The Forests serve their best purpose by promoting settlement and development. The evils

of former conditions, with their rivalries, their injustices, and their wastefulness through overcrowding, are fresh in the minds of all. The purely selfish outcry of those who think themselves strong enough to look out for their own interests, and therefore object to a system which begins by asking who has the best right, is to be expected and must be disregarded.

That the system works well for the stock is attested by the excellent weight and condition which has been attained on the Forest range. No longer hustled from one place to another in hasty competition for feed, they are now brought to the end of the summer in better flesh and with fewer losses than formerly. In short, regulation of the grazing is proving beneficial to the range, to the owner of stock, and to the community. It is turning forage into money to better advantage than could be secured under any other system. Through the recognition given to associations of stockmen those who use the range have a voice in its management, while control by the Government prevents favoritism and insures even-handed justice to all.

The number of stock-grazing permits issued during the year approached 24,000, as against less than 17,000 the previous year, and the receipts were over $850,000, as against $515,000. This increase was mainly the result of additions to the number and area of Forests under administration, but to some extent also the result of improved range condition brought about by grazing control. No charge was made for grazing upon Forests proclaimed after March 1. Another year will beyond a doubt show further increase. The growing volume of business is another illustration of the greater use of the Forests. To handle it has severely taxed the present field force. The greater the number of stock on the Forests the heavier are the demands laid upon the rangers, one of whose duties it is to enforce the grazing regulations. A substantial increase in the administrative force of the Forests will be needed to handle the grazing business of another season.

Of 183 cases of grazing trespass, 165 were settled by the payment of damages. Action for criminal trespass was brought against five trespassers. The constitutionality of punishment for criminal trespass still awaits final determination through decision by the Supreme Court of the United States, but two additional decisions of inferior courts have during the year affirmed the criminal liability of violators of the regulations prescribed by the Secretary of Agriculture. The civil liability of trespassers has never been questioned.

SILVICULTURE.

The practice of forestry begins with the cutting of timber; the principal tools used in cultivating a forest are the saw and the ax. Preparation of the ground for a future crop is accomplished by felling

the mature growth, and control of the character of the future forest is through decision as to what trees shall be removed and what left standing, unless renewal is to be brought about solely through planting. It is, then, through timber sales that forest management is being introduced upon the National Forests.

Receipts from the sale of timber from the Forests increased threefold over those of the year before, and brought in $600,000. But a better gauge of the rate at which the demand of the public for timber is increasing is the contracts made by purchasers. When large bodies of mature timber are so situated that they can be utilized only by a purchaser who can undertake operations on a large scale, sales are made under contracts permitting the work to be continued through several successive years, a specified amount being cut each year. No contracts are made for a longer period than five years. In other words, sufficient time is given to enable a large operation to be carried through, but speculative purchases are not allowed. The sales contracted for during the year totaled 950,000,000 board feet of lumber, besides cordwood and other material, with an aggregate value for all classes of material of over $2,500,000, as against $500,000 sold the previous year.

It is evident that if the demand for timber continues no greater and prices go no higher than at present the Government will in five years be taking in from timber sales at least $2,500,000 annually, since payments will then be coming in on contracts entered into each intervening year. But the demand is certain to increase up to the full amount which the Forests can supply. Eventually it will be necessary to impose a limit to the cut, which must never exceed the rate of growth. Anything beyond this is overcutting. The farmer who fails to make one grain crop last over until the next one matures can usually buy from others, but for many communities dependent on National Forests for their supplies of wood no outside sources of supply are likely to be available. Data are now being gathered from which to compute the present stand and the rate of growth on the different forests, in order that excessive cutting may be prevented.

To become productive, however, a forest must begin to be cut over. No wood is making in a mature forest. Such a forest is simply a storehouse of wood. But after young growth gets under way the forest becomes a manufactory of wood. So far as is consistent with a proper regard for the needs of the future, all mature timber on National Forests is available for use. Waste in utilization of timber cut is not permitted; slash is piled and, if necessary, burned to lessen the fire risk; unnecessary destruction of young growth is prevented; and measures are taken to insure reproduction from self-sown seed.

The work of marking and scaling timber, enforcing contract stipulations, and other matters incidental to the sales, combined with

the demands made by the free-use applications, called for the most strenuous efforts on the part of the administrative force, and often compelled the neglect of other duties.

In addition to the work on the National Forests, forest studies were carried on in cooperation with the States of California, Delaware, Kentucky, and Missouri, and assistance was given to private owners of woodland concerning the management of their tracts.

FOREST PRODUCTS.

Hand in hand with the work which seeks to enlarge our future supplies of timber goes that which seeks to secure the best and most economical use of what we have. Important results have marked the work of the year in this line. The studies of the Forest Service in the field of wood preservation have now reached a point at which it may be predicted with some confidence that the treatment of timber for use under conditions which expose it to rapid decay will soon become widespread. This will mean a marked reduction in the drain upon our forests.

An easy and inexpensive method of treating fence posts has been perfected which makes it possible for any farmer to make the quickly decaying woods, still abundant because hitherto thought almost worthless, far more durable than untreated white oak or chestnut. Demonstrations of this method before southern farmers were received with enthusiasm. For the Middle West, where the common woods are seldom resistant to decay, the matter is certainly no less important. Essentially the same method is being applied to the butts of telegraph poles and to mine props. The enormous consumption of timber for the latter purpose and the extreme rapidity with which it decays in the dampness and darkness of the mine open the prospect of a large economy from the use of this method of treatment, which has stood a searching practical test in Pennsylvania coal mines. By applying the same treatment to timbers from the National Forests a use will be found for dead wood and a decided benefit will be conferred on the users of the timber. The work includes a study of the comparative merits of different kinds of preserving fluids.

The investigations aimed at discovering new sources of paper pulp have demonstrated that a number of woods of abundant supply, never in the past thought of for the manufacture of paper, are capable of yielding pulp of standard grade. Studies in wood distillation are establishing the practicability of obtaining turpentine from waste southern pine material.

Ten thousand separate tests of the strength of timber, largely in the form of full-sized structural beams, have established the relative value of a number of woods and proved the fitness of several of them for hitherto unthought of uses.

Studies of wood production and consumption have added materially to our knowledge of the rate at which we are drawing upon our reserves of standing timber.

BUFFALO IN WICHITA NATIONAL FOREST.

On March 25, 1907, the New York Zoological Society arranged with this Department to establish a herd of American bison on the Wichita National Forest in order to provide for the perpetuation of the species. The Zoological Society offered to send 18 buffalo of pure breed from the New York Zoological Park to the Forest. An appropriation of $15,000 was made by Congress for the purpose of fencing a buffalo pasture and providing the necessary buildings. This work will be completed early in the ensuing fiscal year. An area of about 8,000 acres is inclosed, and the herd placed under the care of a forest officer experienced in the handling of buffalo.

BUREAU OF CHEMISTRY.

INCEPTION OF THE WORK FOR THE ENFORCEMENT OF THE FOOD AND DRUGS ACT.

During this fiscal year an unusual development in the work of the Bureau of Chemistry has taken place, due to the enactment of the food and drugs act of June 30, 1906, which became effective on the first day of January, 1907.

ESTABLISHMENT OF REGULATIONS.

Previous to this date it was necessary to carry out the provisions of the law for the establishment of regulations. To this end a committee consisting of H. W. Wiley, Chief of the Bureau of Chemistry; S. N. D. North, Director of the Census Bureau of the Department of Commerce and Labor, and James L. Gerry, Chief of the Division of Customs of the Treasury Department, acting for the Secretaries of Agriculture, of Commerce and Labor, and of the Treasury, respectively, prepared a set of tentative regulations. Great care was exercised in the preparation of these regulations, not only that the provisions of the law should be executed fully, but also that there should be no unnecessary annoyance or burden placed upon the trade. The regulations were finally completed, signed, and promulgated on October 17, 1906, as Circular 21 of the Secretary's office.

Between January 1 and June 30, 1907, the personnel of the Bureau was more than doubled, the increase being divided among the clerical force, the chemical assistants, and the corps of inspectors. While work incident to the enforcement of the interstate feature of the law was in process of organization, a much more rigid execution of the law relating to imported foods was established. This was possible because under the previous laws the machinery for the inspection and analysis of imported foods had been already well organized.

SUPPORT ACCORDED THE NEW LAW.

Although up to the 1st of July no actual cases had been instituted in the courts under the food and drugs act, the moral effect of it was apparent in every branch of trade connected with the food industry. One of the most gratifying features of this preliminary activity has been the almost unanimous support accorded by the trade to the principles of the law. In most instances manufacturers of food products, as well as dealers therein, have expressed their cordial support of the act and offered their hearty cooperation in securing its execution. The importance of this fact can not be overestimated, since the difficulty of enforcement, if the entire trade were opposed, would be practically insuperable. Supported, however, not only by public opinion, but also by the active collaboration of producer and consumer, the food law will have that moral support which is absolutely necessary to secure more wholesome and properly branded food and drug products for the market.

APPOINTMENT OF FOOD AND DRUG INSPECTORS.

A civil-service examination was held to secure inspectors for the enforcement of the food and drugs act, appointments were made, and on June 3 these inspectors reported at Washington for instructions as to the policy to be pursued in the enforcement of the food and drugs act and the practical details of inspection and sampling. By June 30, 1907, the inspectors had been assigned their respective territories and had taken up temporary headquarters there. In making these assignments two objects were kept in view, namely, the location of branch food and drug inspection laboratories and the strategic positions offered by channels of interstate commerce.

ORGANIZATION OF FOOD AND DRUG INSPECTION WORK.

The board of food and drug inspection was created by the Secretary of Agriculture on April 25, 1907. The duties of the board are to consider all questions arising in the enforcement of the food and drugs act of June 30, 1906. The Bureau of Chemistry is charged under the act to perform whatever analytical work may be required for the information of the board. The board reports directly to the Secretary. Its personnel is as follows: H. W. Wiley, Chemist and Chief of Bureau, chairman; F. L. Dunlap, Associate Chemist; and G. P. McCabe, Solicitor of the Department.

Food and drug inspection laboratories are now established, or are being installed, at New York, Boston, Philadelphia, Chicago, New Orleans, San Francisco, St. Paul, Detroit, Savannah, Seattle, Buffalo, Kansas City, Denver, Galveston, Portland (Oreg.), and Cincinnati. Others will be established as the work requires.

These laboratories examine the imported samples taken at the port of entry and the interstate samples sent in by the inspectors,

referring violations of the law and doubtful cases to the Washington office for action, and releasing those found to be according to law.

FOOD RESEARCH WORK.

In nearly all of the laboratories of the Bureau of Chemistry important research work bearing on practical problems in the analysis of foods, drugs, or cattle foods is in progress, the elaboration of new methods and the improvement of those in use being of the greatest importance in the examination of products under the law. Investigations illustrative of such researches are as follows: Work on the composition and adulteration of flavoring extracts and methods for their analysis; the effect of cold storage on fowl, game, milk, and eggs, in which work the bacteriological chemists play an important part; the study of canning products, such as canned corn, tomatoes, peas, catsups, etc., with special reference to the use of preservatives, including both factory inspection and laboratory experiments; methods for detection of the artificial coating of rice; a study of American honeys, involving the chemical analysis of 112 samples and the microscopical examination of the pollens found therein; an investigation of the ice-cream and milk supply of Washington, D. C., in the course of which about 800 samples were examined from both a chemical and bacteriological point of view; and an analytical and microscopical examination of American cattle foods as found on the market, including 365 samples.

The question of the use of sulphur in bleaching food products has been given special attention and valuable data have been obtained, both as to the accuracy of the analytical methods employed for the detection of free and combined sulphurous acid and as to the extent of the use of this bleaching agent.

The other phase of this question, namely, the effect of sulphurous acid and sulphites as determined by physiological experiment upon 12 young men at the hygienic table conducted by this Bureau, was solved by the compilation and comparison of the data so obtained, which show unmistakably the injurious effects of this preservative, especially in reducing the number of red corpuscles in the blood.

The researches in the drug laboratory included, among others, the examination of samples furnished by the Post-Office Department of drugs sent through the mails, samples of drugs submitted by the Council of Pharmacy and Chemistry of the American Medical Association, the examination of hops and of glycerin to determine whether they were contaminated with arsenic, and of miscellaneous drug products, such as headache powders and so-called "kidney cures." Much important work on methods has been done, including a special study of methods for the detection of enzyms in medicinal agents, especially for the purpose of ascertaining to what extent these bodies render various substances available to the human system.

MISCELLANEOUS INVESTIGATIONS.

Among other important studies conducted in the Bureau of Chemistry, having a direct and practical bearing on the agricultural interests of the country, are the following: Examination of insecticides and fungicides; study of the effects of trade wastes, particularly smelter waste, on vegetable and animal life; investigations looking to the utilization of the native wild sumac as a source of tannin; studies for the development of the wood turpentine industry, and cooperative experiments on the effect of varying climatic conditions on wheats, particularly on newly introduced varieties, and on the sugar content of Indian sweet corn.

CONTRACTS WORK.

The value of the examinations made of Government supplies furnished on contract is shown by the fact that the number of samples analyzed in this laboratory was almost doubled during the past year. The examinations on which the purchase of practically the entire supplies of the Bureau of Engraving and Printing was based alone aggregated nearly 400 samples. The varied character of the samples received makes necessary considerable research work for the development of suitable methods. Both a monetary advantage and an improvement in the character of the supplies is insured by the surveillance of this laboratory.

BUREAU OF SOILS.

There are in the continental United States 1,900,947,200 acres of land. Of this, the Twelfth Census showed 838,591,774 acres in farms, with 414,498,487 acres in improved lands and 289,734,591 acres actually in crops.

With a more thorough knowledge of the soil and its adaptation to crops and the proper methods of soil management, the full extent of the agricultural development which may take place in the United States in the future is very great. The undeveloped portions of the United States are not confined wholly to the arid West, portions of which are now rapidly filling up, although this constitutes the greater part. When we realize that we have 77,000,000 acres of swamp land in the eastern half of the United States—an area equal to all of the New England States, New York, and half of Pennsylvania, or to the combined areas of Illinois and Iowa—which can be reclaimed, and which, under the prevailing climatic conditions, when so reclaimed are exceedingly productive, and when we realize that only 16 per cent of the State of Louisiana, for example, and a smaller percentage of the State of Texas is in improved lands, the possibilities of development become more apparent.

The soil-survey work of the Bureau is the largest undertaking of the kind that has ever been inaugurated in any country. The area surveyed and mapped during the past fiscal year was 20,560 square miles, or 13,158,400 acres, and there have been completed to June 30, 1907, surveys covering a total of 139,247 square miles, or 89,118,080 acres. This area is more than 10 per cent of the amount represented by the farm lands of the United States as given in the preceding page. The work has been so distributed as to include every large representative district in the United States, and has given a knowledge of the soil resources of the country far beyond what was ever conceived of before.

THE PROBLEM OF SOIL FERTILITY.

The Bureau, not content with merely showing the character of the soils and reporting upon their adaptation to crops, has, under the wise provisions of Congressional enactment, been very active in actual demonstrations of the possibilities of further development of these lands in the extension and introduction of new crops and developing new agricultural industries. In addition to this the Bureau has made a special study of some of these soils and of the soil conditions controlling fertility and crop production; and these investigations have given a new view point of the whole subject of soil science, which has aroused a new interest in soil investigations.

As in all large concepts of this character in such a complicated study as the soil and its relation to crop production, it is impossible to see to the fullest extent, while the details of the work are being developed, the broad scope that it may finally cover. It is impossible to see at the present time the bearing that some of the observations made in the laboratories may have in their application under field conditions and cultural methods, but enough has been demonstrated to indicate the substantial soundness of the position which has been taken.

One of the most important problems now confronting the agricultural public is the intelligent use of commercial fertilizers. In some sections of our country, especially in the South and East, the quantities now used are enormous, and this use is gradually extending. That the amount of money annually invested in fertilizers by the farmers of the country, now amounting to upward of $100,000,000, will continue to increase seems certain. But just as certainly a large percentage of the money—perhaps a third—is annually wasted and brings no adequate return, owing to a lack of understanding of the soil's requirements.

This problem has been engaging the attention of the Bureau of Soils for a number of years, and it has been found that this wastage of the farmer's capital is due in large measure to incorrect ideas

which have long prevailed regarding the manner in which the soils feed our crops and the influence of fertilizers upon this feeding. As might be expected from their origin, soils contain numerous fragments of the common rock-forming minerals. These fragments are accompanied more or less by alteration and decomposition products.

It is rarely if ever true that a soil is formed from any particular mineral or rock, but owing to the action of streams, winds, etc., the rock powders comprising the soil are much mixed and intermingled. Consequently it has been found that practically all soils contain more or less of all the common rock-forming minerals, containing among other things the important plant-food ingredients, potash, phosphoric acid, and lime. The important element, nitrogen, is of course supplied from other than mineral sources, either by decomposition of organic remains or from the atmosphere through living organisms.

The widely diffused minerals of the soil are all slightly soluble in the soil water, and it has been shown that this solution is the natural source of food supply for the plants. As the dissolved plant nutrients are removed, either by the growing plants or by other natural agencies, the minerals continue to dissolve and thus replenish the solution. As these minerals are so widely distributed in various soils, the mineral composition of the plant-food solution is not very different in different soils. The natural processes following evaporation at the surface of the soil, from plant leaves, etc., cause an upward movement of soil moisture from the subsoil, and often from great depths. These solutions rising from below carry dissolved mineral plant nutrients; but when they reach the surface soil the strength of the solution there is not much increased, owing to a power of absorption or the fixing of these salts which the soil possesses. Thus the soil is in a sense "enriched" by these desirable constituents, although the actual feeding medium for the plant is not essentially altered. Similarly, artificial enrichment of the soil by commercial fertilizers does not materially affect the mineral composition of the soil solution, as is popularly supposed, but has other profound and far-reaching functions which our recent researches are now making clear.

It has been found that infertility in soils is very frequently due to the presence of bodies deleterious to plant growth, and the difficult task of isolating and identifying these bodies and studying their effects on plant growth has been undertaken in the work of this Bureau. Several of these substances have actually been removed from the soil and their properties determined. It has been shown that these bodies of organic origin result, under unfavorable soil conditions, from the decay of plant tissue, from excreta of germinating seeds, and from excreta of roots of growing plants. Under favorable

soil conditions and under cultivation, proper drainage, suitable crop adaptations, crop rotations, and judicious use of fertilizers these organic bodies are absorbed or destroyed, providing a suitable and healthy environment for crops. Crop rotation is especially useful, since it has been found that the excreta of one plant are not necessarily deleterious to another kind of plant, and different species of plants themselves aid in the destruction and removal of deleterious organic substances. Of no less importance, because they are subject to better control, are the natural manures and artificial fertilizers. A rational use of these means of soil control, and especially of commercial fertilizers and soil correctives which now absorb so large a proportion of our farmers' working capital, is the fundamental problem of present day agriculture.

It is most gratifying to be able to announce such substantial progress in the investigations of the real causes for the fertility or infertility of our agricultural lands.

TOBACCO SOILS.

As a direct result of the soil surveys and of the laboratory investigations, the possibility of producing a finer textured tobacco wrapper leaf in the Connecticut Valley was taken up, and it has been developed to a point where it is assured that a leaf approaching the Sumatra tobacco in texture, but with other local and distinctive characteristics, has been produced in the Connecticut Valley; and, largely as a result of the Bureau's work in Florida, the American-grown wrapper leaf has taken a foremost rank, is being exported to foreign countries, and is taking its place in real competition with the Sumatra leaf. The interest in this shade-grown product has grown to large proportions and the extension of this industry is contingent to a very large extent upon the soil surveys which shall point out the soils upon which this desirable leaf can be produced.

On certain soils in Texas and Alabama the Cuban type of leaf has been introduced as a direct result of the soil surveys, after a thorough examination of the soils and conditions of growth in Cuba, and as a result of demonstration work by the experts of the Bureau of Soils there are now hundreds of acres of land in both of these States producing the finest filler leaf, suitable for high-grade cigars.

Of so great importance has this work appeared that an informal application has been made by officials in Cuba for the extension of the soil survey to that country, to aid them in the further development and the better understanding of their own soils and the improvement of their tobacco industry.

In New York the reason for the variation in the type of tobacco has been found in the fact that the adaptation of the soils to the different varieties of tobacco has not formerly been understood or con-

ceived, and the entire solution of the perplexing problem of the commercial crop in New York is now in a fair way of being solved by the utilization of the soil maps of the tobacco districts and the adaptation of varieties and of cultural methods to the soils suitable for particular commercial grades.

In Ohio the whole method of fermentation and handling of tobacco has been changed, with important results in the improvement of the crop and the prevention of the losses which occurred under the old methods of handling the leaf.

In Virginia not only has marked improvement in the grade of tobacco produced been shown to be possible by the Bureau's work, but by the proper handling of the soil through modern methods of culture and of fertilization the lands have been left in so much better condition after the tobacco crop has been removed that without further special treatment the yield of subsequent crops of wheat has been increased threefold and the lands have produced heavy crops of hay where formerly this crop was not even considered a possibility.

While the soil problems concerned in tobacco culture are receiving attention in the Bureau of Soils, to avoid any seeming conflict or duplication of work I have transferred all the cultural work in tobacco to the Bureau of Plant Industry for investigations on the further improvement through selection of seed and breeding, while the Bureau of Soils will continue its soil survey and soil investigations of the important tobacco districts as a basis for continued improvement and a safe development of the whole specialized industry of tobacco culture.

PRACTICAL USES OF SOIL MAPS AND REPORTS.

Incidentally the War Department has on file a complete set of the soil maps thus far made, and is supplied, at its request, with copies of all soil-survey reports as soon as issued for the information of the military service in deciding on camp sites, on the character of the soils over large districts where they may be called to operate, and for other information that may be of importance in military plans.

The Post-Office Department is utilizing the maps to a considerable extent and frequently calls for advance copies for assistance in the location of rural free-delivery routes. Life-insurance companies and trust companies are availing themselves of the information contained in the soil-survey reports and maps in assessing risks and making investments of money. Nurserymen and seedsmen are availing themselves of the information furnished regarding the crops and fruits adapted to certain soils in certain localities. Plow manufacturers are utilizing this work to the extent of modifying farm machinery for adaptation to certain soils and certain regions to produce the most efficient work in cultivation.

By detailed soil surveys the Bureau is furnishing expert advice on the crop adaptations of the soils in those areas where irrigation schemes are effecting a change from extensively dry-farmed wheat ranches to intensively farmed fruit and alfalfa ranches.

In cooperation with the United States Reclamation Service, soil surveys are being made of the projects soon to be available for settlement upon completion of the necessary storage reservoirs and canals constructed by Federal effort. The soils of many of these projects have never been cultivated, and the newcomer to be successful must have the best information obtainable about the soils and the most profitable crops.

The successful introduction of new crops in the semiarid region depends largely on the ability of the soil to conserve the scant rainfall. Surveys have been made of many areas in this region, chiefly in North Dakota, to outline those soil types on which crops can be cultivated with safety.

The soil survey reports, by calling attention to the soil resources and the opportunities offered to acquire good farm lands at a low figure, have frequently been of great assistance to the railroad companies in colonizing the territory in which they operate. Appreciating the value of the information contained in the reports, the railroads have in some cases arranged with the lithographic firms for specially large editions of the soil maps for distribution among prospective settlers.

Many large-scale detailed soil surveys have been made of experiment station farms and agricultural high school farms showing all of the minor differences in the soils of each farm. These soil maps have proved of great value in connection with the various plat fertilizer and rotation experiments conducted on the different farms.

Demonstration experiments on all the various kinds of alkali land found in the arid West have shown that the farmer need no longer dread alkali, but that such land can be easily reclaimed and made productive. The alkali problem has been satisfactorily solved and is in reality not as serious as many of the soil problems confronting the eastern farmer.

Special study of the viticultural soils in California has shown that there is a direct relation between the soil and the color, yield, and commercial value of the grape; that there are large bodies of soil very well adapted to various kinds of grapes, and that the grape industry can be greatly extended in many parts of California.

Soil surveys and special study have shown that there are large areas of soils in Arkansas and California that are peculiarly suited to rice culture and that the introduction of this crop will prove a boon to farmers owning such land, which has hitherto been held to be of low agricultural value.

Investigations of the apple soils of California have shown that there is a close relationship between the keeping qualities of the apples and the various kinds of soils on which they are grown. This is very important and should prove of great value to apple growers in planting new orchards.

Soil surveys of swamp lands reclaimed generations ago as well as surveys and special studies of unreclaimed swamps in many States have shown the possibilities of swamp soils. The knowledge that some of these reclaimed swamp lands are still exceedingly fertile after one hundred years of constant cropping without fertilizers has helped arouse a general interest in the drainage of swamps. Again, the information brought out by the soil survey that certain swamps contain lands of low agricultural value shows the importance of a thorough knowledge of the soil and its possibilities before we can plan intelligently reclamation schemes involving the expenditure of large sums of money.

The results of the work of the Bureau of Soils have been presented directly to the people of the United States through the medium of educational tours conducted in ten different States. There have been held over 100 meetings for which the Bureau of Soils has contributed speakers to discuss the results of soil-survey work and methods of soil utilization and soil management. A great interest has been manifested in these meetings, and an opportunity has been afforded for answering many questions which were presented to the speakers in connection with this work.

The Bureau has assigned men to many localities in which soil surveys have been made to advise with farmers in regard to the character of their soils, the crops which may be grown to the best advantage, and methods of handling the soils to derive the greatest returns. The demand for this character of work is increasing as the number of completed soil surveys increases.

The fertilizer requirements of extensive soil types are being determined through laboratory and greenhouse methods and field observations in order to effect a saving in the fertilizer bill of the country.

Field investigations have been made to increase crop production on extensive areas of different soil types which, with the usual methods of cultivation, do not yield particularly remunerative crops. In many cases slight modifications of the methods of mechanical handling of the land increase the crop-producing power of such soils to a marked degree. Frequently tile drainage or the use of open ditches or other simple measures has been found sufficient. In other cases increased depth of plowing, change from spring plowing to fall plowing, the growth of cover crops to protect the land from washing during the winter rains, or the incorporation of organic matter with the soil,

serves to render soils formerly held in little esteem of high producing value. This work is being developed as fast as possible.

The soil survey has found extensive areas of soils well suited to alfalfa culture, not only in Texas, but also in northern Mississippi and in central Alabama. It has been found that alfalfa soils occur in New York in localities where this industry has not yet been established, and in other Northern States as well. Upon some of these soils practically no other crop of high value is grown at the present time. The soil-survey work should be extended in order to outline more fully the localities where these soils exist. A special study should also be made of the preparation, the tillage, and the manurial requirements of these soils for successful alfalfa production.

The Bureau has materially aided in the development of the early truck and fruit industry in the Atlantic and Gulf Coast States. It has shown that there is a close relationship between the soils of different localities and the character of the truck crops which can be raised. The principal requirements of soils suited to early truck crops have been found to be small clay content, insuring excellent drainage and ease in cultivation and quick response to applications of fertilizers, and nearness to bodies of water, insuring freedom from frost. The soil survey has outlined large areas of land suitable for early truck and has been instrumental in the development of this important industry.

The Bureau is studying the characteristics of soils best suited to the production of the different varieties of cotton, notably the long staple and some of the improved varieties which are being used in an attempt to meet the boll-weevil conditions of the Southern and Southwestern States. Investigations have shown that types of cotton which grow to perfection upon loose sandy lands rapidly lose their essential characteristics if the seed from such cotton is planted on heavy clay soils or upon moist bottom lands.

Large areas of timber land have been cut over through a considerable portion of the South Atlantic and Gulf States and also in portions of the States bordering the Great Lakes. The proper use of these lands has not been well understood during the past, and it has frequently been maintained that with the removal of the timber these soils were of very small value. It has been found, however, that by the adoption of special methods of tillage, including the incorporation of organic matter and a moderate degree of fertilization, many of these soils are capable of producing the ordinary staple crops to good advantage. Some of these soils in the South Atlantic and Gulf Coast States have been found to correspond closely with the highly valuable truck and market-garden soils which have already been highly developed agriculturally.

Investigations have been made of the agricultural possibilities of the Piedmont section of the eastern United States. The rapid development of manufacturing interests throughout this section, with the accompanying growth of consuming population in the larger cities and towns, will soon render necessary the local production of such food supplies as are now to a marked degree shipped into these communities from remote localities. Changes from the production of staple crops to the production of special crops require careful study of the adaptation of soils to crops and the proper management of the soils and particularly of the application of fertilizers and manures. In addition, many other cities of the central and southern United States are becoming aware of the necessity for the production of a large part of the perishable food supply of such cities in near-by districts. The importance of such investigations is emphasized by the marked growth of urban population as contrasted with a slight growth in rural population, or, in some cases, with an actual decrease of population in the farming districts.

Soil surveys have been undertaken in some of the New England States to determine the capabilities of lands which were formerly cultivated to corn, wheat, oats, and other grain crops, but which since have reverted to pasturage or have been altogether abandoned. It has been found that considerable areas of the rougher, steeper lands should be planted to seedling white pine trees, in order to insure a renewal of the timber supply of those sections, and that such an occupation of the rougher lands is probably the most desirable use to which they could be put. The more favorably situated soils can be profitably used for fruit and vegetable crops, which may be raised to advantage, and a ready market can be found among the summer resorts of this section of the country. The hill pastures of this section are well suited, under proper methods of cultivation and seeding, to the production of valuable pasture and forage grasses, by means of which the sheep industry may be reestablished throughout a considerable portion of the New England States. This would seem to be particularly desirable, as sheep do not require the extensive production of corn or other grain feed.

Careful study has been made in southern New York, northern Pennsylvania, and northeastern Ohio of approximately 10,000 square miles of hill and plateau belonging to a single soil series, over which the character of farming at the present time is not well suited to the soils or the climatic conditions. In this region there has been a continued tendency toward more extensive farming and away from specialization in crop production. In some cases attention has been called to the actual desertion of farm homes and to the coalescing of smaller farms into the larger holdings. This study has made evident

the fact that the introduction of special crops, and particularly the adoption of proper methods of soil cultivation and soil fertilization, would make possible a more profitable system of farming. The present price of farm lands throughout this area is so low that these lands offer exceptional opportunities for the development of the orchard industry, animal husbandry based upon the production of grass and small grain crops, the production of white potatoes, and certain other specialties adapted to the general locality. These lands are located within a short distance of the greatest centers of population in the United States, and might be made highly productive and certainly remunerative with proper methods of crop adaptation and soil management.

SOIL EROSION.

Another line of work in the Bureau relates to soil erosion. According to the latest determinations (beginning with the classic measurements of the Mississippi by Humphreys and Abbot) the rivers of mainland United States are annually pouring into the seas fully 1,000,000,000 tons of sediment. This sediment is carried partly in solution, but chiefly in suspension, in the 35,000,000,000,000 cubic feet or more of river water drained from the United States, and is additional to the coarser detritus pushed or rolled along the sides of the swifter streams. The volume of material thus lost to the land is increasing with settlement and cultivation; it is almost wholly washed from the surface and is the very richest soil material, the cream of the soil. The value of the material is not easily fixed, but at a moderate appraisal the annual loss would exceed all the land taxes of the country. Besides impoverishing the soil, the sediment pollutes the waters, reducing their value for domestic and manufacturing purposes and endangering the lives of those compelled to use them, and causes streams to scour their channels and build bars; and through scouring and building it compels the lower rivers to shift and overflow, thereby reducing the value of fertile bottom lands. However estimated, the loss is enormous, and the chain of evils resulting from the annual erosion of this billion tons of soil is long and complex, and leads directly back to the farm.

The nature of the soil is determined by the water within it. When rains fall or snows melt on the land, the water passes in different ways. A part evaporates directly into the air; another part (generally much larger) flows down the slopes to the streams and thence to the sea—this is the run-off; a third fraction soaks into the soil and subsoil and thence into the underlying rocks, perhaps to reappear in springs or as seepage into streams—this is the ground water; still another part is absorbed by organisms (chiefly trees, grasses, crop plants, etc.) either directly through tissues or indirectly through roots penetrating the moistened soil. Erosion is due directly to the

run-off, of which the ratio is dependent partly on slope, but chiefly on the nature of the soil and its product; indeed, with any reasonable slope, a full cover of forest or grass with an abundant mulch, or a close crop on deeply broken soil, or a friable furrow slice kept loose by suitable cultivation, will so fully absorb precipitation as to curtail the run-off or even reduce it to slow seepage through the surface soil—the ideal condition and the one toward which modern agriculture should be bent. It is the third fraction—the ground water—that forms the most essential constituent of the soil, for solution, circulation, and organic assimilation are all absolutely dependent on water; indeed, the greater part of all organic tissue is made up of this solvent, which comprises a large percentage of the bodies and of the food of man and lower animals.

The ratio of ground water in the soil is vital. All soils contain more or less, though if the quantity is small it may be too firmly locked up in mechanical combinations to be available for plants, as in deserts which are naturally barren, yet burst into fruitfulness with a few acre-inches of irrigation. If the quantity is excessive, circulation may be so impeded that cultivation only settles the soil in a sodden mass—sticky when wet, baked crust when dry—while the surcharged condition prevents further absorption and sends the waters of storm and thaw over the surface to engage in destructive erosion even on easy slopes. The fraction of natural water supply assimilated by organisms is susceptible of control and increase by selection of crops and by maintaining the requisite soil texture and ratio of soil water, and these means tend directly or indirectly toward counteracting and eventually eliminating erosion. Thus water is not merely the chief value inhering in the soil, for it is susceptible of such control as to multiply its benefits and eliminate its evils.

The immediate source of our prosperity is the soil of the American farm, and it is a National duty to see that the soil is conserved and the farm improved for the immediate benefit of the farmer and the ultimate welfare of the country. One of the richest assets of the nation is the water that falls on the farms, permeates the soil, permits organic growth, and after enriching the land flows seaward through the Commonwealths to furnish substance and power and afford means of commerce; and it is coming to be recognized as one important duty of the Nation to see that this water shall be so controlled and conserved as to yield the greatest benefits to the holders of the land on which it gathers, and eventually to all the people. At the same time the evils of soil erosion begin on the farm, and while they extend thence to the pollution of the streams of the States and the obstruction of interstate rivers, it is becoming clear that the remedy must begin with the farm and that it is a National duty to see that the remedy is prescribed and applied.

Some of the remedial devices may be noted. Since the chief object is to so regulate the capacity of the soil for water that it will absorb the product of each rainfall or thaw without run-off and retain the moisture for both plant supply and seepage, deep cultivation is desirable. This is useful, too, not only in bringing up fresh earth salts to within reach of the shorter rootlets, but in performing the still more important office of carrying down humus and mulch to thicken the soil and feed the deeper roots.

In flat-lying fields and tenacious soils, where the ground water moves sluggishly, deep underdrainage (preferably tile) is required. The primary effect of deep drainage is to permit both soil and subsoil to crumble and disintegrate, and through the mechanical and chemical changes thereby induced to become friable and susceptible of retaining the right amount of moisture for plant growth; the secondary effects are reduction of surface run-off and checking of erosion, and acceleration of stream flow after storms through the quicker gathering of the storm waters. The clear flow from the drains neither pollutes nor obstructs the streams, but leaves their waters in condition for ready control by other means.

On rolling farms contour cultivation is desirable; the plow furrows and crop rows should be carried along the slopes in such manner that each furrow and row will lie level; when the plow and cultivator, instead of opening runnels to be enlarged into gullies by the first storm, will close runnels and gullies already opened and form receptacles in which the storm waters may lodge until soaked into the soil.

On hilly lands the contour cultivation should be supplemented by "balks" or "breaks," i. e., by strips of grass land separating belts or zones of plowland; and these, like the furrows, should curve with the slopes in plan and lie level in elevation. They should be carefully laid out; for, properly managed, each grass-land balk with the belt of plowland next above it will grow into a terrace without special effort, since some soil descends when stirred by plow or storm and lodges in the upper margin of the sward, raising this line until both plowland and grass land are brought into equilibrium.

Over foothills and deeply broken country ordinary agriculture should grade into silviculture and forestry, perhaps combined with horticulture and grazing; for here storm waters tend to gather into torrents, quickly passing beyond control if once allowed to form, yet easily prevented from forming by making mulch and soil so deep and spongy as to absorb not only the gentle rain, but the inch or two sometimes dropped by thunderstorm or cloudburst.

Over all mountain divides and crests below timber line forests should be retained and extended; for, as seen by settlers and happily expressed by Spanish-speaking neighbors, the mountains are the mothers of waters, and nearly every lofty range is a local "Sierra Madre," and the clearness and purity of these waters and their

uniformity of flow is proportionate to the perfection of the forest cover. In earlier decades, when forests were viewed only as obstructions, silviculture was profitless; but now that the accumulated growth of a thousand years has been largely squandered, forestry is becoming a branch of agriculture no less profitable than others. It remains only to classify and assign our slopes and soils to those crops to which they are best adapted, whether these be grains or grasses or vines or trees.

In extending the principles and applications of American agriculture three steps are contemplated in the operations of the Bureau—education, individual action, and collective action.

The education need involve little more than diffusion of information on a few leading points, such as the magnitude of the annual loss due to soil erosion, the facility with which this can be checked, and the certainty that the remedy can be made not only inexpensive, but actually profitable to each person applying it. Given this information, American intelligence and enterprise may be counted on to meet the occasion.

The chief individual action required is along the lines of improved agriculture, with more intensive methods, more thoughtful conservation of soil matter and crops and their by-products, more careful attention to ground water; and here, as elsewhere, public spirit is the strongest incentive to private conduct.

In general the collective action will develop materially with the growing knowledge of communities, yet it should be aided as needed by State and Federal instrumentalities. The keynote to such action sounds in the social principle that in the long run the good of the individual is the good of the community, and in the legal principle that each so use his own as not to injure others. The direct loss through soil erosion is very great and begins on each farm and affects every community. The indirect loss is no less, perhaps greater, for the streams are fouled, water power is jeopardized, navigation is impeded or prevented, and floods are raised; and since in the end the responsibility rests with the men on whose farms the evil starts, the remedy must begin with the farming community and should be guided by the interests of the whole people.

BUREAU OF ENTOMOLOGY.

Excellent results have been gained by the work of this Bureau in the course of investigations that have for some time been under way, and by order of Congress new investigations have been begun.

THE MEXICAN COTTON BOLL WEEVIL.

This very destructive insect has shown itself more adaptable to changed conditions, and therefore more capable of extending spread, than any other insect originating in the Tropics that has ever entered

United States territory. It has established itself, contrary to anticipations, north of the line of early frosts, and there will probably be no climatic barrier to its spread throughout the whole cotton belt. Its northward and eastward spread has continued since my last report, and in the early autumn of 1907 it was found to have crossed the Mississippi River and to have entered the State of Mississippi.

Under the greatly changed conditions of soil and moisture existing in the bottom lands of Louisiana and Mississippi, the insect is changing its habits.

PARASITES AND NATURAL ENEMIES.

The careful studies that have been carried on have shown, however, that as the period of the occupancy of United States territory by the boll weevil lengthens the native parasites and natural enemies are becoming accustomed to it and are attacking it with increasing effectiveness year by year. It is now known that fifteen different insects which attack the boll weevil in its immature stages are at work in the infested territory, and the number is undoubtedly increasing. This is not a matter of small importance, since during the past season in a field near Waco, Tex., it was found that fully 40 per cent of the weevils had been killed by the combined work of several species of parasites. Practical results of parasite work are in sight, and in one experiment the mortality rate of the weevil was raised 9 per cent in two weeks by the introduction of parasites from one region to another where they were absent, or present in small numbers.

There are a number of species of weevils that attack native weeds, but which will not attack cotton. The parasites of these native weed-feeding weevils will attack the cotton boll weevil; and it has been found, after careful study of these insects and of their parasites, that where the natural food plants of the native weevils are destroyed about cotton fields at a certain time, the parasites of these weevils, in the absence of their normal food, will attack the cotton boll weevil to such an extent as very considerably to increase the mortality of the boll weevil. The native fire-ant, occurring throughout the cotton belt, is rapidly acquiring the habit of feeding upon the boll weevil. In one case, at Beeville, Tex., where the boll weevil has been known for at least twelve years, during the past year in a certain field three-fourths of the weevils in fallen squares were found to have been destroyed by this ant. Careful studies have been made and are now being made of the special conditions favorable to the increase of this ant and of the different parasites, and it seems very probable that practical results will follow.

FIELD EXPERIMENTATION.

As in preceding years, a number of large-scale experiments in different regions where the weevil problem assumes a local aspect were

carried on. Nearly 1,000 acres, in lots varying from 10 to 65 acres in extent, were used in this work.

Most important results have been gained in a test of the efficacy of the fall destruction of cotton plants. In one isolated locality in Calhoun and Jackson counties, Tex., badly infested with the weevil, 410 acres, comprising all of the cotton in that vicinity and separated from other cotton plantings by about 10 miles, were cut during the first ten days of October, 1906. In Lavaca County, 30 miles away, a considerable quantity of cotton is grown at Six Mile Settlement. This cotton was not destroyed, and the fields were kept under observation as a check. The results were as follows:

In May, 1907, in the experimental fields only one weevil was found, whereas in the check fields practically all of the squares had been destroyed. In September, 1907, the cotton in the experimental fields showed a yield of about 1,000 pounds of seed cotton per acre, while in the check fields the average was about 350 pounds of seed cotton per acre, and this in spite of the fact that the soil on the check area is much richer than that in the experimental area. The destruction of the plants in October has caused the poorer land to produce practically three times as much cotton as the richer land. The proper treatment of the fields in the experimental area resulted in an advantage to the farmers of $20 per acre.

The result is that by systematic fall destruction of cotton plants boll weevil damage can largely be averted, the reason being that by such destruction many millions of weevils in one stage or another are killed which otherwise would successfully pass the winter and infest the next year's crop.

OTHER COTTON BOLL WEEVIL WORK.

Extensive experimentation on the hibernation of the weevil was carried on; many laboratory observations and experiments were made; careful tests were made of all recommendations and suggestions that contained any element of probable success; the question of late planting versus early planting was again tested, with the result of a perfect proof of the fallacy of the late-planting idea; and a machine was devised for the destruction of the insect in fallen squares which bids fair to be of considerable value. The northward and eastward spread of the weevil was carefully watched and predictions of damage were issued from time to time. The results published in June, 1907, indicated that the damage to be expected from the boll weevil during the year would be much less than normal. This prediction was verified by the later results.

The work in cooperation with the State experiment stations was continued. One man was detailed to the Texas Experiment Station and three to the Crop Pest Commission of Louisiana, which is virtually a part of the experiment station organization in that State.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

During the past fiscal year work against these two destructive insects in New England was taken up under a special appropriation by Congress. Headquarters were established in Boston; a skilled agent was placed in charge; a large force of laborers was engaged, and energetic work was begun as soon as the appropriation became available. Under the terms of the appropriation the work has been directed toward preventing the further spread of the gipsy moth and the brown-tail moth, and the work has been largely concentrated upon the gipsy moth, for the reason that it can more readily be handled and spreads much more slowly, owing to the fact that the female can not fly and the species spreads largely by the accidental carriage of the caterpillars on vehicles of different sorts and by pedestrians. The brown-tail moth flies readily and its range is much greater than that of the gipsy moth. It is easily destroyed in the winter time by the destruction of the winter nests, and an educational campaign in cooperation with the States of Maine, New Hampshire, Massachusetts, and Connecticut has been undertaken with a view of inducing property holders to accomplish the destruction of this species on their own grounds. With the gipsy moth the effort has been to destroy the insect along the main traveled roads for a distance of 100 feet or more back from the roads, thus preventing the caterpillars from spinning down from overhanging trees upon vehicles passing by. This work was started in the main centers of infestation, since these are the principal sources from which the insects are disseminated.

Such roads in 11 towns in the most thickly infested portions of Massachusetts have been cleared up, and at the present time conditions are vastly improved. In the meantime careful scouting has been carried on around the borders of the territory known to be infested, with the result that the gipsy moth has been found in many places in southern New Hampshire and at a large number of points in southwestern Maine, where it was heretofore unknown to exist. The States above mentioned and the State of Rhode Island have passed laws and have appropriated comparatively small sums of money to be used in the fight against the gipsy moth and the brown-tail moth, and conditions are such in Maine, Rhode Island, and Connecticut that the object aimed at is the extermination of the insects. The fall scouting of 1907, so far as it has as yet developed the situation, seems to show that in Maine the insect has secured a much greater foothold than was formerly supposed, but nothing has thus far developed to render extermination impossible. In New Hampshire scouting work is now going on, and since all of the colonies of the gipsy moth so far found are in orchards or along roadsides, and not in the forests, it is not improbable that extermination may

be accomplished in that State. The condition as a whole is encouraging, and it is quite possible that the gipsy moth will be prevented from any further dangerous spread and at the same time can be greatly reduced in numbers. In Rhode Island, for example, the past year's work has resulted in the destruction of 95 per cent of the insects.

INTRODUCTION OF BENEFICIAL INSECTS.

PARASITES OF THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

The introduction of the parasites and predatory insect enemies of the gipsy moth and the brown-tail moth referred to in my last report has been continued with great success, and it is reasonably certain that the gipsy moth, as shown in the preceding paragraph, can be held in check by mechanical means until these imported natural enemies shall bring about a condition such as exists in Europe, where this insect only rarely appears in great numbers and then only for a single season.

In the early summer of 1907 the Chief of the Bureau of Entomology again visited parts of Europe, extending the range of his search for parasites into central and southern Russia, and by cooperation with European entomologists succeeded in introducing a much larger number than ever before of European parasites of the eggs and of the larvæ and pupæ of both the gipsy moth and the brown-tail moth. Two new species of primary parasites were introduced from Russia, and one of these proves to be a very rapid breeder and promises the best results.

These insects have been cared for in large indoor and outdoor breeding cages in the vicinity of Boston, and many thousands of specimens have been liberated in the open. There is abundant proof that several species have established themselves, and there is every reason to suppose that they will breed with greater or less rapidity. It is hoped that the results of the work of these parasites will be evident by the summer of 1909, and there is a possibility that they may be evident in 1908.

The life histories and habits of these parasites are being studied by expert assistants in the laboratory near Boston, and careful observations at the same time are being made by agents of the Department in France and in Russia. Aside from the new species imported from Russia, the most encouraging feature of the year's importations is probably the abundance of parasites of the eggs of both the gipsy moth and the brown-tail moth that have been brought to America. Six generations of one species have been followed through during the past summer.

Altogether 35 species of these beneficial insects have been imported. Of these, 14 are hymenopterous parasites, 16 are dipterous parasites, and 5 are predatory beetles. There have been colonized in the open

9 species of hymenopterous parasites, 14 of dipterous parasites, and 2 of predatory beetles, making 25 species in all. Certain evidence of the practical acclimatization of a number of these forms has been gained.

OTHER IMPORTATIONS.

Aside from continued importations of several species of European ladybirds, which are effective enemies of plant lice and other soft-bodied insects, a systematic effort has been begun to import and acclimatize the European parasites of the codling moth. The State Board of Horticulture of California has already imported one parasite of this destructive insect and has it breeding in confinement at Sacramento, but the California organization has refused to distribute this parasite in other States except for large cash payments. The Department is therefore making the effort for the good of the whole country and will introduce not only a single parasitic species but as many as possible. Several hundred cocoons of the codling moth have already been received from different parts of Europe and are being cared for in the insectary of the Department at Washington.

What may prove to be an important egg parasite of the imported elm-leaf beetle has been discovered in France, and infested egg-masses have been sent to this country in the hope of establishing the parasite on this side of the ocean. This year's sendings were started too late, but in view of this experience it is hoped that next season this parasite may be brought over successfully.

THE SENDING OF USEFUL INSECTS ABROAD.

As indicated in previous reports, European officials have been so generous in their assistance to this country in these importations of beneficial insects that the Department has endeavored to return the courtesy wherever possible. Continued sendings of scale-insect parasites have been made during the year to Italy with promise of success.

An interesting cooperative experiment was begun during the year with the French Government, and successful sendings of a predatory wasp from the Southern States to Algeria were made. On arrival in Algeria these wasps were cared for by agents of the Pasteur Institute of Paris, acting for the French colonial government, in the effort to establish a species which will destroy the gadfly, which carries a very destructive disease of the dromedary, so important in that country as a beast of burden.

FIELD-CROP INSECTS.

During the year the investigations of the Hessian fly and the different species of jointworms have been carried on, and work has been done with the so-called green bug which injures grain in the West in the early part of the season.

HESSIAN FLY INVESTIGATIONS.

The wheat-sowing experiments have been increased during the year, and are now being carried on in eleven States, over 800 different sowings having been under constant observation this year. Exact data are being continually accumulated, showing that it is possible to evade the most serious portion of the fall attack of the fly by seasonably late sowing in the fall, and exact dates under certain conditions for the different localities are being gradually established. These experiments, acting at the same time as demonstrations, are attracting much attention and are carefully watched by the farmers throughout the sections where the experiments are located.

An important branch of the Hessian fly work has demonstrated the possibility of the practical use of the parasites of the fly, and this is brought about by the careful study of the experimental sowings. A striking example has developed during the year. Early sown plats at Lansing, Mich., and Marion, Pa., were seriously attacked by the fly, but when examined at a later date fully 90 per cent of the flaxseeds were found to have been stung by a certain species of parasite and to contain its developing larvæ. At this time a field of wheat near Sharpsburg, Md., was found to be infested by the fly and examination indicated the absence of parasites. On April 8 some thousands of the parasitized flaxseeds from Pennsylvania were brought to Maryland and placed in the field. On July 8 an examination of the Maryland field showed that the parasites had developed so rapidly as to bring about an almost total destruction of the fly.

INVESTIGATIONS OF THE SO-CALLED GREEN BUG.

A destructive outbreak of this insect was carefully studied by several expert assistants. It began in Texas in January, and then consecutively in the States to the North, until it finally appeared across the Canadian border. Many remedies were tried, and a large-scale experiment was carried out in the carriage of early developing parasites from the South to more northern localities, liberating them in infested fields. Important results were obtained, and it was apparently shown that under the conditions under which the experiments were made this year there is little or nothing to be gained by such transportation of parasites, since they develop almost simultaneously in northern fields into which southern parasites have not been introduced. Further experimentation of this kind, however, must be carried out before exact conclusions can be announced.

JOINTWORMS AND OTHER GRAIN INSECTS.

Experimental work with the wheat jointworm and the timothy jointworm has been continued, and it has been shown that a proper rotation of crops will practically prevent damage by both insects.

Further investigations have been made on the seed-corn ground beetle and the corn-root aphis and a number of other insects belonging to this group.

WHITE FLY INVESTIGATIONS.

By order of Congress, and under a special appropriation in response to strong demands from the Florida citrus-fruit growers, an investigation was begun on the white fly, an insect which does great damage to orange and lemon groves. A special agent with ample assistance was located in Florida, and life history studies have been made, experiments carried on in the introduction of parasitic insects, and in the encouragement of fungous diseases, and also in the control of the insect by the use of insecticides and gases. Much information of distinct value has resulted. Parasites of native insects of the same family have been brought from different parts of the country, and some results have been obtained which indicate that in the more humid portions of Florida the fungous diseases of the insect may be encouraged. The thorough investigation of the use of liquid sprays has progressed, and experiments in the use of hydrocyanic-acid gas indicate that under favorable conditions—that is, isolation from other infested groves, or where concerted action can be had—fumigation is much more economical than spraying and much more certain in its results than reliance on natural enemies.

INSECTS AFFECTING TOBACCO.

In the bill making appropriations for the Department for the present fiscal year a clause was inserted providing for investigation of insects injurious to tobacco in the dark tobacco belt of Tennessee and Kentucky. An expert assistant was sent to the region late in May, 1907, to make a preliminary examination of the field. Studies were made of the tobacco flea beetle, which seems to have been especially injurious this year, of cutworms, of plant lice, and of a few other species. Experimental plats at two important points were arranged for and cooperation with the Tennessee and Kentucky experiment stations was also arranged. A permanent special agent was placed in the region in question, and his work is now well under way.

INSECTS DAMAGING DECIDUOUS FRUIT TREES.

In addition to the continuation of investigations already in progress, an important new project has been taken up, namely, the study of the pear thrips and other deciduous fruit insects in portions of California. A station has been established at San Jose, an expert has been placed in charge, and the destructive pear thrips is being studied with the greatest care.

The plan of maintaining field stations in parts of the country devoted to the growing of deciduous fruits on a large scale has

proved to be an excellent one, and in this way it has become possible to thoroughly study the insects being investigated under perfectly normal conditions and to conduct tests of remedies on a commercial scale. This work and the tests of insecticides is carried out according to a uniform plan, and thus shows variations in the life and habits of a given species in different parts of the country and what changes should be made in the use of remedies.

To the work in Pennsylvania has been added an investigation of the destructive grape rootworm. Demonstration spraying in the control of the codling moth and apple disease in cooperation with the Bureau of Plant Industry has been carried on at several points, and the work upon the plum curculio and the peach tree-borer, as well as that upon the San Jose scale, especially in the investigation of different washes, has been continued.

BEE CULTURE.

The chief problem taken up in this work was the investigation of the brood diseases of bees, and a bulletin on this subject was prepared and published. Careful bacteriological work has been done on these diseases and a number of obscure points have been cleared up.

Work on bee paralysis, a disease of adult bees, has been carried on by an agent in California. This is a most obscure disease, and no evidence of the influence of a micro-organism has as yet been found.

Distribution of breeding material of the various known races of bees has been carried on, and work on experimentation with honey-producing plants has also been continued.

An interesting series of tests has been begun as to the comparative value of the various races of bees in fertilizing red clover.

SILK CULTURE.

No changes have been made in the methods that have been followed for some years past in the effort to continue the production of silk in the United States. Eighty-five ounces of tested eggs were imported from Italy and distributed to 343 applicants in the spring. About 11,000 seedlings of the best white mulberry were also distributed. Cocoons were purchased from American growers at a rate varying from 90 cents to $1.15 per dry pound, and these cocoons were reeled at the Department. The reeled silk on hand was sold during the year at $4 a pound, bringing in a return of $1,012, which was deposited with the Treasury Department in compliance with the regulations.

INSECTS INJURIOUS TO VEGETABLE CROPS.

In the course of the year the investigations of insects of this class have been continued with a larger force than ever before, and some excellent results have been obtained. For example, in a series of

cooperative investigations made between the Bureau and the Texas Agricultural Experiment Station on the melon aphis, great success has been obtained in the elaboration of remedial measures and in the demonstration of their efficiency. Especial attention has been paid to insects injurious to truck crops in the South, the region from which the early vegetables are sent to the northern markets.

Investigations of sugar-beet insects have been continued, and a full report upon the beet leaf-hopper, which has been very destructive in Utah and Idaho in recent years, is practically completed.

INSECTS INJURIOUS TO FORESTS.

In this direction very satisfactory progress has been made both in acquiring and diffusing information of practical value to the forest interests of the country. Especial work has been done upon insects that prevent forest reproduction, and those injurious to forest products, both crude and finished. Damage done by powder post beetles to finished hardwood material has been investigated with the result that successful methods of control have been ascertained. Studies have been made of beneficial forest insects looking toward their practical utilization. The studies of the damage by bark beetles to coniferous trees have been continued, and recommendations of the Bureau have been adopted with excellent results.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

The work of the Bureau on the subject of mosquitoes has been continued, and a complete account of the mosquitoes of North America, including some consideration of their relations to disease, is nearly finished.

The investigation of the life history of the Texas cattle tick and other injurious ticks which may be concerned in the transmission of disease has been continued in cooperation with different State entomologists, and many important points having a direct bearing upon methods of control have been ascertained. A true parasite of one of the ticks has been found which offers hope that natural methods of decreasing the abundance of ticks may yet be learned.

OTHER INVESTIGATIONS.

Elaborate work on the destructive group of scale insects has been carried on through the year. Insects injurious to stored products have been further studied. Elaborate tests of different insecticides have been made, and radical inspections have been made of all of the plant material introduced by the Department and sent out, so that the danger of spreading insect pests in this way is practically removed. Investigations of the insects affecting the pecan in the South have been begun.

BUREAU OF BIOLOGICAL SURVEY.

Practically all the investigations under way in the Bureau of Biological Survey at the time of the presentation of my last report have been continued and additional and important lines of work have been begun.

ECONOMIC VALUE OF BIRDS.

The education of the public as to the value of birds generally and the part they play in the economy of nature is felt to be an important part of the duties of the Survey. School children especially need enlightenment, both as to the value of birds and as to the duty of the citizen toward them. During the last year circulars have been issued with this important educational end in view.

ECONOMIC INVESTIGATIONS.

THE BOLL WEEVIL.

Work in relation to the ravages of the boll weevil was continued in Texas and Louisiana with gratifying results. Several additional birds were found to feed on the weevil, bringing the number of species now known to prey on it up to 43. A report detailing the results of the season's observations has been published, and it is hoped that its wide dissemination in the cotton States will have two important results: (1) The enactment of necessary protective legislation for several species of birds not now protected; (2) the enlightenment of all classes of citizens in the cotton States as to the important part certain birds play in limiting the ravages of the pest, and also the enlistment of their cooperation in protecting and in increasing the numbers of the birds that destroy the weevil. That the latter is entirely practicable can not be doubted, at least in the case of swallows, which are among the most persistent enemies of the weevil. While these useful birds are under protection of law in the Southern States as elsewhere, it has been ascertained that in certain districts their nests are broken up and the birds driven away or destroyed, under the mistaken idea that they harbor insects obnoxious to man. Such is not the case, and it is believed that if wide publicity is given to the facts the birds, instead of being persecuted, will be encouraged, as they should be, to build in every available site. A substantial increase of numbers would enable them to wage more effective war against many injurious insects, including the worst offender of all, the boll weevil.

BIRDS IN RELATION TO FRUIT RAISING.

For several years work has been conducted in the fruit regions of California to determine the exact status of birds in their relation to this great and growing industry. The vicinity of orchards is known

to be a favorite home of birds, but by no means all the birds that nest in and about orchards are attracted by the fruit. On the contrary, numerous species choose orchards as their home, or as their hunting grounds, because of the multitude of insects which infest fruit and fruit trees. Careful examinations of the stomachs of orchard birds show that by the destruction of injurious insects most of the birds that eat fruit more than compensate for the damage they do. The moderate amount of fruit consumed by such species may properly be looked upon as pay for services rendered, and it may be added that the service is cheaply bought. In the case of certain species which are harmful to the fruit growers' interests remedial methods are suggested.

SCALE-EATING BIRDS.

Special investigations have been made to determine the extent to which birds prey on scale insects. These dangerous pests are so small and so sedentary that they have been generally supposed to be overlooked by birds. Such proves to be by no means the case, and no fewer than 57 species of birds have been ascertained to feed on scales. Moreover, certain birds, the grosbeak, for instance, appears to have a special fondness for them and to hunt them assiduously.

TRAFFIC IN CAGE BIRDS.

The fact that 300,000 cage birds are yearly imported into this country and that the number is constantly increasing will surprise many. By far the greater number of these importations are canaries, or other cage birds. There seems to be no reason why most if not all the cage birds required in this country should not be raised here. The industry is very profitable in Germany and elsewhere abroad, where it is carried on, not in a wholesale way, but by the women and children of individual families who, with comparatively little labor and trouble, add an interesting occupation to their ordinary household duties and secure satisfactory returns in cash. The mountain regions of the Southern States, particularly, would seem to furnish almost ideal conditions for such an industry, which, besides being lucrative, possesses the added advantage of substituting domestic birds for such wild species as the mocking bird, cardinal, and nonpareil, whose value to agriculture is too great to make it desirable to confine them in cages.

DUCKS AND SHORE BIRDS.

In the past one of the important food sources of the United States was its game, particularly its ducks, geese, and shore birds, thousands of which found their way to the markets of all our large cities to be used for food by rich and poor. Unfortunately the natural supply of these birds was not wisely husbanded with an eye to the future, but, as in the case of the buffalo and wild pigeon, was mercilessly

pursued till at the present time not a few species are threatened with speedy extinction. The subject is important, and it is obvious that if the more desirable species of ducks and geese are to be preserved for the future, additional legislation is needed. The essential data to serve as a basis for legislative action are a knowledge of the food supply and of the pairing times of the several species of ducks, geese, and waders; and of the routes they pursue in migration. These subjects are now being carefully investigated.

ECONOMIC MAMMALOGY.

The problems connected with this branch of the work are many and important. While in some sections of the country the devices employed to reduce the number of noxious mammals, especially the smaller rodents, have proved successful, in many others the reverse is the case. Traps, poisons, and gases, when intelligently employed, are efficient, but they often stop short of serving the desired end owing to want of cooperation. They must be used at the proper seasons, must be employed persistently, and, to secure the best results, should be employed simultaneously by all the farmers over a wide extent of country. In many regions, unfortunately, cultivated areas alternate with strips of wild and unimproved land, so that the latter form nurseries from which adjoining farms are populated anew after the number of rodents has been reduced to harmless proportions, Thus warfare against mammals is ceaseless and expensive and constitutes a heavy tax upon agriculture.

It is with a view to the discovery of more effective and cheaper methods of destroying rodents that experiments with contagious diseases have been continued in cooperation with the Bureau of Animal Industry. A very important field for this work is among the small ground squirrels of the Northwest, where these animals annually destroy vast quantities of grain. Laboratory experiments have yielded promising results, and work along this line will be continued with the hope of securing a virus which can be utilized in reducing the number of rodent pests throughout the affected area.

THE RABBIT PEST.

Complaints of damages to orchards and various other crops by rabbits continue to be received. Experiments were continued during the past year with a view to the discovery of a protective wash for fruit trees, and excellent results were obtained with the lime-and-sulphur wash, well known as a remedy for the San Jose scale. The wash can be made in quantities very cheaply, and it seems to protect fruit and other trees perfectly from the attacks of both rabbits and mice. It is also durable in effects, one liberal application lasting all winter. Should further experiments confirm the efficacy of this

wash as a protection for trees against the attacks of small rodents, an important problem will have been solved, as the annual destruction of orchard trees by rabbits and mice reaches large proportions.

HOUSE RATS.

No one of our wild mammals, possibly not all combined, does so much damage as the common rat. Many experiments have been made to discover satisfactory methods of checking the depredations of these animals and of reducing their numbers. A bulletin setting forth the most approved methods known was issued during the year with the expectation that it will materially aid in the protection of property from the attacks of these pests. Meanwhile experiments with bacterial diseases are being continued for the purpose of discovering a safe and effective virus, fatal to these rodents and yet harmless to domesticated animals.

FIELD MICE.

Though small, field mice are so generally distributed over the United States and so numerous in certain regions that they often do great damage in gardens, meadows, nurseries, and orchards, where they attack fruit trees and crops. Alfalfa is particularly relished by these rodents, and, as it is very nutritious, when once they have invaded a patch they increase enormously. As in summer they attack the foliage and in winter the roots, if unchecked they soon destroy whole fields and render fresh planting necessary. They thus possess considerable economic importance. A careful study has been made of their habits and such methods of prevention suggested as have been found most efficacious are set forth in a bulletin which is now being widely distributed.

WOLVES.

Methods of destroying wolves that prey upon stock on the western ranges have been carefully studied and two reports on the subject were issued last year—one, in cooperation with the Forest Service, in relation to the destruction of stock on the western ranges; the other in connection with the destruction of deer in Michigan and Wisconsin. The adoption by stockmen of the methods recommended—especially killing the young in the breeding dens—has already resulted in a material reduction in the number of wolves and a corresponding saving of stock and game.

GEOGRAPHIC DISTRIBUTION—LIFE ZONES AND CROP ZONES.

The essential purpose of this work is to furnish the practical farmer a guide to the crops best fitted for any given area. From a study of our native fauna and flora it has been found that the country is divided into zones or belts, each characterized by certain conditions of temperature and by the presence of particular species of

mammals, birds, reptiles, and plants. Each of these primary life belts covers an extensive transcontinental area, which in turn is subdivided into minor areas. It has been found that crops adapted to one part of an area thrive under similar conditions in other parts and will not thrive in areas having materially different conditions. By means of this knowledge, in connection with the zone maps, a vast deal of costly experimentation is saved. Life-zone maps of the several States are now in course of preparation, to be followed by lists of crops and fruits best adapted for cultivation in the different areas. The great demand for the generalized map and report already published and for the more detailed maps not yet finished is an earnest of the practical importance of this work.

Field work in several States, as California, Colorado, and New Mexico, is now being carried on with a view to early publication of results. Considerable work has been done in other States, and it is hoped that sufficient funds will be forthcoming to permit this work to be completed as rapidly as possible, especially in the States where large irrigation projects are expected to make available immense tracts of hitherto nonagricultural land.

GAME PROTECTION AND INTRODUCTION.

ENTRY OF FOREIGN BIRDS AND MAMMALS.

The act of Congress of May 25, 1900, prohibiting the entry into the United States of the mongoose, English sparrow, flying fox, and starling has now become so well known that for the past two years none of these pests has been offered for entry, nor has constant vigilance disclosed any attempt to introduce them surreptitiously.

The importance of a check upon the possible introduction of pests into the United States grows with the growth of the trade in cage birds, which is increasing very rapidly. During the year, besides 708 mammals, 408,532 birds were imported under permit, an increase of 27 per cent over those of the preceding year and 51 per cent over those imported in the year ending June 30, 1905. Of this large number, 351,407 were canaries. Nearly all were entered at New York and Philadelphia, and all but a comparatively small number were subjected to careful inspection by the Department's representatives at those ports. In addition to its value as a means of preventing the introduction of injurious species, the service presents features of more than ordinary interest in revealing the extent and character of a trade concerning which little has been generally known.

Its usefulness further appears in the fact that it keeps the Department informed of the importation of foreign game birds for the purpose of stocking American covers. Our own game birds are constantly diminishing in abundance, and the practice of introducing foreign birds as a substitute grows in favor. Many species, serving

both for food and sport, have already been more or less firmly established in various parts of the country. During the year Illinois imported more than 1,000 European partridges, and Kansas imported about 2,000 English pheasants. Capercailzie and black game of northern Europe, the former of which is nearly as large as wild turkey, have been imported successfully for liberation at various points, notably on Grand Island, Michigan, and in the Algonquin Park, Ontario.

The experiment of stocking covers by means of imported eggs of game birds also is apparently meeting with favor. Under the act of June 7, 1902, every such consignment requires a permit from the Department. More than 5,900 eggs were imported during the year. In number this was but a slight increase over those brought in in 1906, but the fact that they were imported in 39 different consignments, as against 5 in the preceding year, shows a much more widespread interest.

INTERSTATE COMMERCE IN GAME.

The most important feature in the suppression of illegal interstate commerce in game was the arrest of two noted tusk hunters, and the confiscation of a large quantity of hides, horns, and teeth of elk they had secured in the Yellowstone Park and vicinity. The men involved in this particular transaction were tried for a violation of the Lacey Act in shipping their plunder from Idaho to California. They pleaded guilty and were promptly fined $200, the minimum penalty under the Lacey Act. It is greatly to be regretted that the demand for the heads, horns, and especially the tusks of elk should threaten the extinction within our territory of this noble game animal, and every effort should be made by National and State authorities to protect the few remaining head. The high price paid for trophies, especially the teeth, is an incentive to pursue the animals. The practice of hunting elk has been conducted with disregard of the Federal and State laws, and has been very destructive.

Attention is called again to the importance of additional supervisors to be stationed at central points to represent the Department in its efforts to abolish unlawful interstate commerce in game. It is impossible for the Department to secure adequate enforcement of the Lacey Act without increase of its force. Local conditions must be studied, evidence must be secured, and it is often essential, as with other branches of the Government service, that the Department be represented at the trials of important offenders. The cost of such additional force would be slight and the benefit very great.

BIRD RESERVATIONS.

No new reservations were established during the year, but the seven already created were maintained under careful supervision. Some poaching was reported by the warden of Stump Lake Reserva-

tion, in North Dakota, but as three of the poachers were arrested, promptly convicted, and fined $25 each, the example will probably have a deterrent influence.

PUBLICATION OF INFORMATION CONCERNING GAME.

One of the most serviceable duties of the section of game preservation consists of informing the public of existing laws relating to protection and hunting of game and special features connected therewith. Within the last twenty years game laws have become so numerous and complicated, as compared with the simple provisions of former times, that it is exceedingly difficult, without some such central source of information, for the sportsman or dealer in game to acquaint himself with the various requirements of State laws. Such information not only interests and benefits the general public, but frequently serves as a basis for State legislation. Perhaps the most important publication prepared by this office during the year was one treating of the methods and machinery employed in the enforcement of game laws.

PRESERVATION OF GAME IN ALASKA.

During the last session of Congress a bill was introduced placing the duty of issuing permits for the export of trophies and specimens from Alaska with the governor of the Territory, instead of with the Department, and providing for the issue of licenses. The bill, however, failed of passage, and for the present the Department will continue its conservative policy in regard to the issue of export permits. I am impelled to renew my recommendation that Congress relieve the Department of the duty of enforcing the Alaska game law. The present law is unsatisfactory, both to the residents of Alaska and to this Department.

COOPERATIVE WORK.

Much attention is given to cooperative work, chiefly in connection with the establishment and maintenance of efficient game and bird protection in the various States. Special aid was given to Alabama, California, Connecticut, Delaware, New Jersey, New York, Pennsylvania, Tennessee, Texas, Vermont, Virginia, and Wisconsin. Requests for such aid are of increasing frequency, but are complied with so far as possible. They involve chiefly explanations to legislatures, or legislative committees, of certain special features of game protection, and of assistance in cases arising from violations of game laws.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

To appreciate properly the present importance of this Division and the rapidity with which its responsibilities are increasing it is only necessary to consider the growth of the Department as a whole, as shown by the appropriations for agricultural investigations and related purposes since its inception in 1839. In that year $1,000 was

set aside by Congress "for the purpose of collecting and distributing seeds, prosecuting agricultural investigations, and procuring agricultural statistics." In 1849 the appropriation had increased to $3,500 and in 1859 to $60,000. In 1862 the importance and value of the work, until then prosecuted under the direction of the Commissioner of Patents, had secured such recognition that a department headed by an independent Commissioner was created for its continuance. In 1869 the agricultural appropriation amounted to $172,593, in 1879 to $206,400, and in 1889 to $1,034,480, by which time the administration of the financial affairs of the Department had developed such importance that a separate division became necessary to insure proper disbursement of the funds set aside by Congress for the needs of the Department. In 1899 the annual appropriation had increased to $2,829,702, but during the past ten years the growth of the Department has been rapid and the benefits to the public have increased correspondingly. The regular appropriation bills of the Department for ordinary and routine expenses from 1903 to 1908, inclusive, show an average annual percentage of increase of 12.9.

The amount estimated for the fiscal year ending June 30, 1909, in the regular appropriation bill is $10,666,351, which includes $720,000 for agricultural experiment stations. This is an apparent increase of $1,459,061, or 15.8 per cent; but, taking into consideration the loss of revenues derived by the Forest Service from the sales of timber, etc. (estimated at $1,500,000 annually), which heretofore have been used for maintenance of the reserves, but which, beginning on July 1, 1908, are required by law to be deposited in the Treasury to miscellaneous receipts, it is in reality no increase. In addition there will be a permanent appropriation of $3,000,000 for meat inspection, and an item of $550,000 in the sundry civil bill for printing and binding for this Department, to be done under the Public Printer, making a grand total of $14,216,351.

The proper disbursement of the great sums now being appropriated annually for the use of the Department at the present time involves the careful scrutiny, administrative examination, and audit of more than 50,000 accounts annually and the issue of about 75,000 checks. This duty, which is performed by the Division of Accounts and Disbursements, insures a conformity of the expenditures to the requirements of the appropriation acts and the regulations of the Treasury Department, in addition to which absolute economy of disbursement is secured by the departmental system of project filing which was developed over two years ago for the purpose of insuring judicious and careful expenditure and of rendering any duplication of work in the several bureaus absolutely impossible. In the operation of this system each chief of Bureau files a detailed statement every six months regarding each project in operation or contemplated

in his particular Bureau. With these statements before him, the head of the Department is enabled to coordinate and direct the work of the several Bureaus to the greatest possible advantage. Over 1,300 projects are on file, and no new projects are embarked upon without being first brought to the attention of the head of the Department in the manner described. It may be remarked in this connection that the system of project filing here outlined is peculiar to and entirely original with the Department of Agriculture.

During the fiscal year ending June 30, 1907, the Congressional Committee on Expenditures in the Department of Agriculture carefully investigated the expenditures for the preceding fiscal year. In the course of this investigation all the higher officials of the Department appeared before the committee and under oath explained in detail the character and object of the various lines of work being prosecuted by the Department. It is gratifying to state that as a result of the examination every penny of the agricultural appropriations was properly accounted for, the work and discipline of the Department received high commendation, and it was shown that the annual value of the Department of Agriculture to the general public at the present time is nearly a quarter of a billion dollars. As the annual appropriation for the Department is about $14,000,000, it will be seen that this is a return of about $16.50 for every dollar appropriated by Congress.

For the prosecution of the various activities of the Department of Agriculture during the year ending June 30, 1907, including the permanent appropriation of $3,000,000 for meat inspection and other special appropriations, Congress appropriated the sum of $11,557,691.36, this amount being $4,382,001.36 in excess of that similarly appropriated for the preceding year. The disbursements of the Department during the fiscal year 1907 amounted to $8,586,209.23, and the greater part of the balance of $2,971,482.13 will be required for the settlement of outstanding liabilities.

The amount paid for rent of buildings in the District of Columbia in the several branches of the Department was $50,148.96.

All accounts for the fiscal year 1905 having been settled, the unexpended balance of appropriations for that year, amounting to $74,336, was covered into the Treasury on June 30, 1907. The account for the fiscal year 1906 is still open.

DIVISION OF PUBLICATIONS.

The results of the investigations conducted by the Department are made known and become available for the use of the people by means of publications, of which 1,415 were issued during the year, 596 being new and 819 reprints. These publications comprised 52,363 printed pages and the total number of copies aggregated 16,746,910, an increase of 3,258,889 copies over last year.

The publication work of the Department has assumed such magnitude that only by the most careful editorial supervision and by the enforcement of the most rigid economy in the printing and by the exercise of constant discretion in the distribution of the documents has it been possible to accomplish the results attained with the present appropriation. It has become absolutely necessary to reduce the editions of the scientific and technical publications to sufficient numbers to supply only restricted lists of cooperators, educational institutions, experiment stations, and libraries, and to refer miscellaneous applicants to the Superintendent of Documents, who, under a wise provision of law, is authorized to reprint our publications and sell the same at a nominal price so long as there is a demand for them. The fact that last year 71,764 copies of various publications of this Department were sold at an aggregate price of $10,885.20 is indisputable evidence of the willingness of applicants to purchase publications in which they are interested and thus to contribute toward the support of the publication work of the Department. If the publications could be placed on sale at the post-offices throughout the United States, and thus made easily procurable, I feel confident that the people would buy them. In this way the wide dissemination of the practical information they contain would be insured, which is not possible under the system now in vogue and with the funds available for printing and binding.

FARMERS' BULLETINS.

Farmers' Bulletins continue to be the most popular publications of the Department. Forty-two new bulletins were issued during the year, the number of copies printed being 1,100,000, while 443 reprints of bulletins were made in editions aggregating 5,369,000, the total number of Farmers' Bulletins printed in the year being 6,439,000 copies, of which 3,484,713 were distributed upon the order of Senators, Representatives, and Delegates in Congress. The fund appropriated for the preparation and printing of these bulletins remains at $98,750, which is inadequate to print the number required, and I have asked for $125,000 for next year, with the view to increasing the number allotted to each Senator, Representative, and Delegate in Congress to 15,000 copies and to enable the Department to supply the increasing demand for these publications. The total number of Farmers' Bulletins printed and distributed since the series was created in 1889 is 55,125,000, of which 37,400,161 have been distributed by Members of Congress.

It would be difficult to estimate the increased value of the crops of this country resulting from the adoption of the improved methods of farming described in these bulletins, which have been distributed in such large numbers to every section of the United States.

PUBLICATIONS SPECIFICALLY AUTHORIZED BY LAW.

There are nine publications of this Department the annual printing of which is specifically authorized by law. Under the provisions of Joint Resolution No. 14, approved March 30, 1906, it is permissible to order any part of the edition instead of the total number of copies specified. The Department has availed itself of this provision, and instead of printing the greatest number allowable, which was 68,000 copies, only 46,100 were ordered, thus effecting a saving of $15,000.

WEIGHING THE MAIL.

In accordance with a provision of the act making appropriations for the Post-Office Department for the fiscal year ending June 30, 1907, the Division of Publications weighed carefully the mail forwarded through the post-office under penalty envelopes during the first half of the fiscal year, the results of which are interesting, inasmuch as the principal distribution of the publications of the Department is made through this Division. The record shows that during that period 3,698,725 packages, weighing 622,988 pounds, which would require at ordinary postage rates $66,450 to provide stamps, were delivered to the city post-office. An accurate account of the entire year's distribution can not be obtained by doubling these figures, as the demands for the Department's publications during the last half of the calendar year are not so great as during the winter and spring months. Therefore it is a fair estimate to place the weight of the domestic mail forwarded by the Division of Publications at more than 1,500,000 pounds. In addition, there were mailed to foreign countries, prepaid by postage, 44,426 packages, weighing 14,426 pounds 13 ounces, at a total cost for postage of $1,474.98; and 134 packages, weighing 508 pounds 4 ounces, were forwarded through the Bureau of International Exchange, Smithsonian Institution, as the weight of each package was in excess of the limitations imposed by the foreign countries to which they were mailed. Furthermore, there were forwarded to the Dominion of Canada, Mexico, and Cuba, under the frank, 15,909 packages, weighing 3,972 pounds. Many of the publications thus forwarded were sent by registered mail. A card index is kept of the distribution of the more important bulletins and reports, and a careful record is kept of every publication distributed, the Division of Publications being charged with this distribution under the provisions of the act of January 12, 1895.

TO FACILITATE THE REPRINTING OF OUR PUBLICATIONS BY THE AGRICULTURAL EXPERIMENT STATIONS.

There is a growing desire on the part of the agricultural experiment stations to distribute publications of this Department, especially those that relate to subjects in the investigation of which there has

been cooperative work. Unfortunately the Department fund is insufficient to permit the printing of the copies desired for distribution by the stations. I strongly recommend some modification of the law of January 12, 1895, relating to the public printing and binding, which would authorize the Public Printer to sell at reasonable prices to the directors of the agricultural experiment stations electrotype plates of the publications of the Department. This would enable the stations to reprint at small expense any publication of this Department, thus insuring a wider dissemination of the information contained in our publications than is possible with the present appropriation for printing.

BUREAU OF STATISTICS.

GROWTH AND DEVELOPMENT OF CROP STATISTICS.

The first provision for the collection of agricultural statistics by the Department of Agriculture was made by Congress in 1863. At that time the United States was entering upon a period of rapid development of agricultural and commercial resources, and there was felt by different branches of business a necessity for the collection and dissemination of additional information regarding the crops of the country.

The requirements of foreign markets brings about dependence upon the United States for agricultural products. To meet these demands at home and abroad is the province of American agriculture. The manufacturer, the merchant, the skilled operative in the factory, to as great an extent as the farmer, feels deeply interested in the reports of the condition and progress of an agriculture upon which all are dependent.

Statistical information concerning crop production and live stock that is collected by the slow and exact methods of a census is generally not given to the public until after the crops enumerated are harvested and marketed and the immediate interest in such statistics has passed away. Price movements of agricultural products are primarily governed by the law of supply and demand, and so a knowledge of the supply as early as practicable is essential. Those who produce and those who consume have interests as well as the dealer who operates between them. The mutual interests of agriculture, manufacture, and commerce demand that there should be published at brief intervals during the crop season reliable information on the condition, acreage, production, and value of the principal crops.

The life of commerce being the exchange of the products of agriculture and manufacture among producers and consumers, commerce prospers in proportion as the farmer prospers and the operative thrives. Some individuals, however, do not regard the common welfare, and injurious speculations occur when ignorance of the condition

of our crops prevails. At such times the farmer does not obtain just prices, the consumer is not benefited, and business is injuriously affected. The consequences of false reports concerning the prospective yield or condition of the cotton crop alone might be very injurious. If there were no adequate Government crop-reporting service and the cotton crop should receive the full force of the reports of harmful speculators, for every cent per pound that prices were unfairly depressed the growers would lose 60 million dollars or more; if the prices were improperly increased, the manufacturers and allied interests would be affected to a proportionate degree. All interests, therefore, demand that the true condition of crops should be made known promptly.

It was to remedy these evils and to subserve and protect the interests above noted that Congress has provided for issuing monthly crop reports. From an allotment of a few thousand dollars each year the crop-reporting service has been evolved, perfected, and enlarged into the Bureau of Statistics. The total cost of such service from its beginning down to date has been about 3½ million dollars.

The first enactment authorizing the collection of agricultural statistics by the Department of Agriculture was the act establishing the Department, passed May 15, 1862, "the general design and duties of which shall be to acquire and to diffuse among the people of the United States information on subjects connected with agriculture, in the most general and comprehensive sense of that word."

METHODS OF CROP REPORTING.

The general plan of the crop-reporting service has not undergone material changes during the past year. Efforts have been devoted to perfecting and improving many details of the organization.

The Bureau of Statistics issues each month detailed reports relating to agricultural conditions throughout the United States, the data upon which these facts are based being obtained through a special field service, a corps of State statistical agents, and a large body of voluntary correspondents composed of the following classes: County correspondents, township correspondents, individual farmers, and special cotton correspondents.

The special field service is composed of seventeen traveling agents, who are especially qualified by statistical training and practical knowledge of crops, each assigned to report for a given group of States. They systematically travel over the districts assigned to them, carefully noting the development of each crop, keeping in touch with best-informed opinion, and reporting monthly and at such other times as are required.

There are forty-five State statistical agents, each located in a different State. Each of these reports for his State as a unit, and main-

tains a corps of correspondents entirely independent of those reporting directly to the Department at Washington. These State statistical correspondents report each month direct to the State agent on schedules furnished them. These are then tabulated and weighted according to the relative product or area of the given crop in each county represented, and summarized by the State agent, who coordinates and analyzes them in the light of knowledge of conditions derived from personal observation and other sources, and prepares his monthly and other written and telegraphic reports to the Department.

There are approximately 2,800 counties of agricultural importance in the United States. In each of these counties the Department has a principal county correspondent, who maintains an organization of several assistants. These county correspondents are selected with special reference to their qualifications, and constitute an efficient branch of the crop-reporting service. They make the county the geographical unit of their reports, and, after obtaining data each month from their assistants and supplementing these with information obtained from their own observation and knowledge, report directly to the Department at Washington.

In the township and voting precincts of the United States in which farming operations are extensively carried on the Department has township correspondents who make the township or precinct the basis of reports, which they also send to the Bureau of Statistics each month.

Finally, at the end of the growing season a large number of individual farmers and planters report on the results of their own individual farming operations during the year, and valuable data are also secured from 30,000 mills and elevators.

With regard to cotton, all the information secured from the foregoing sources is supplemented by that furnished by special cotton correspondents, embracing a large number of persons intimately concerned in the cotton industry, and, in addition, inquiries in relation to acreage and yield per acre of cotton are addressed to the list of cotton ginners through the courtesy of the Bureau of the Census.

SCOPE OF CROP REPORTS.

Eleven monthly crop reports on the principal crops are received yearly from each of the special field agents, county correspondents, State statistical agents, and township correspondents, and one report relating to the acreage and production of general crops is received during the year from individual farmers.

Six special cotton reports are received during the growing season from the special field agents, from the county correspondents, from the State statistical agents, and from township correspondents, and the first and last of these reports are supplemented by returns from individual farmers, special correspondents, and cotton ginners.

TRANSMISSION OF REPORTS TO BUREAU BY CORRESPONDENTS.

Previous to the preparation and issuance of the Bureau's reports each month, the several classes of correspondents send their reports separately and independently to the Department at Washington.

In order to prevent any possible access to reports which relate to speculative crops, and to render it absolutely impossible for premature information to be derived from them, all of the reports from the State statistical agents, as well as those of the special field agents relating thereto, are sent to the Secretary of Agriculture. By an agreement with the postal authorities these envelopes are delivered to the Secretary of Agriculture in sealed mail pouches. These pouches are opened only by the Secretary or Assistant Secretary, and the reports, with seals unbroken, immediately placed in the safe in the Secretary's office, where they remain sealed and guarded until the morning of the day on which the reports are issued, when they are delivered to the Statistician by the Secretary or the Assistant Secretary. Reports from special field agents and State statistical agents residing at points more than 500 miles from Washington are sent by telegraph in cipher. Those in regard to speculative crops are addressed to the Secretary of Agriculture, by whom they are placed in the safe in his office.

Reports from the State statistical agents and special field service in relation to nonspeculative crops are sent to the Bureau of Statistics and are kept securely in a safe until the data contained in them are used by the Statistician in compiling estimates regarding the crops to which they relate. The reports from the county correspondents, township correspondents, and other voluntary agents are sent to the Chief of the Bureau of Statistics by mail in sealed envelopes.

PREPARATION OF REPORTS.

The plan of placing the final preparation of the reports in a crop-reporting board has been continued during the past year, and after two full years of trial it has been demonstrated that it is a satisfactory method. It relieves one man of the strain and responsibility and secures the benefits of consultation and the consensus of judgment of men who have been on the ground.

The crop-reporting board is composed of the Chief of the Bureau as chairman and four other members whose services are brought into requisition each crop-reporting day from among the statisticians and officials of the Bureau and the special field and State statistical agents who are called to Washington for the purpose.

The personnel of the board is changed each month. The meetings are held in the office of the Statistician, which is kept locked during its session, no one being allowed to enter or leave the room or the Bureau, telephones being disconnected.

When the board has assembled, reports and telegrams regarding speculative crops from State and field agents, which have been placed unopened in a safe in the office of the Secretary of Agriculture, are delivered by the Secretary, opened, and tabulated, and the reports, by States, from the several classes of correspondents and agents relating to all crops dealt with are brought together in convenient parallel columns on final tabulation slips. The board is thus provided with several separate estimates covering each State and each separate crop, made independently by the respective classes of correspondents and agents of the Bureau, each reporting for a territory or geographical unit with which he is thoroughly familiar.

Abstracts of the weather condition reports in relation to the different crops, by States, are also prepared from the weekly bulletins of the Weather Bureau. With all these data before the board, each individual member computes independently, on a separate sheet or final computation slip, his own estimate of the acreage, condition, or yield of each crop, or of the number, condition, etc., of farm animals for each State separately. These results are then compared and discussed by the board under the supervision of the chairman, and the final figures for each State are decided upon. It has been interesting to note how often the reports of the different classes of correspondents and agents are very nearly identical, and how closely the figures arrived at independently by the individual members of the board agree. The estimates by States as finally determined by the board are weighted by the acreage figures for the respective States, the result for the United States being a true weighted average for each subject.

There have been 18 meetings of the crop-reporting board during the past year, in most of which the personnel has been changed each month. Six special field agents, specialists in their respective lines of statistical and crop knowledge, and eight State statistical agents have served in the different board meetings. Most of these men are widely known throughout the United States, and the practice of having them take part in the preparation of the monthly crop reports and estimates has proved highly satisfactory, and has been a great factor in establishing the confidence of the public generally throughout the country in the fairness and correctness of the Bureau's estimates.

In 1905 comprehensive and stringent orders governing the preparation of the crop reports were promulgated. They have been found to secure expedition and safety in the computations, and have satisfactorily safeguarded the reports. Such orders have been revised to date and are strictly adhered to in every detail.

METHOD OF ISSUING REPORTS.

Reports in relation to cotton, after being prepared by the crop-reporting board and personally approved by the Secretary of Agriculture, are issued on the 2d or 3d of each month during the grow-

ing season, and reports relating to the principal farm crops and live stock are prepared and made public on the 9th or 10th day of each month. In order that the information contained in these reports may be made available simultaneously throughout the United States, they are handed, at an announced hour on report days, to all applicants and to the telegraph companies. These companies have reserved their lines at the designated time, and forward immediately the figures of most interest. A mimeograph or multigraph statement, also containing such estimates of condition or actual production, together with the corresponding estimates of former years for comparative purposes, is prepared and sent immediately to a mailing list of exchanges, newspaper publications, and individuals. The same afternoon printed cards containing the essential facts concerning the most important crops of the report are mailed to the 77,000 post-offices throughout the United States for public display, thus placing the most valuable information within the farmers' immediate reach.

STATE STATISTICAL AGENTS.

Particular efforts have been made during the year to improve and perfect this important class of correspondents, and special care has been exercised in the selection and appointment of new agents where vacancies have occurred from death and resignations. Only men possessing proper qualifications and fitness have been selected, and then only after careful investigation by representatives of the Department. Many of the State agents have been visited and their offices inspected by officials of the Bureau during the year, and it is gratifying to note that their methods of securing data and compiling their reports have been brought to a scientific and uniform basis.

The appropriations of this Bureau were somewhat increased last year, and one of the principal reasons was to enable the State statistical agents to travel within and throughout their respective States for the purpose of making personal investigations of crop conditions, and of meeting their correspondents or aids, and enlisting the services of new ones. About $5,000 was allotted for this purpose during the year, and the State agents were directed to travel in the spring at the time inquiries are made as to the acreage of the principal crops, and also in the fall or near the time of harvest, when inquiries are made as to the yield and production. Excellent reports have been received from the different agents as to the great assistance and advantage of this travel, and it is felt that such benefits have been reflected in improved and more accurate reports from such agents.

SPECIAL FIELD AGENTS.

By means of a slight increase in the appropriation of this Bureau the corps of field and traveling agents was increased by the appointment of two additional men, and the territories of several of the

agents have been redistributed and reassigned, so that the entire country is now better covered and represented by this class of reporters. The number of agents has been increased to 17; the principal cotton-producing States are now covered by 6 agents, while 8 others are assigned to the remaining territory of the United States, including the principal wheat and corn producing States, and 3 others are principally engaged in collecting statistics throughout the United States in regard to such crops as tobacco and rice.

INTERNATIONAL TRADE AND PRODUCTION STATISTICS.

Renewed efforts were made during the year to enlarge the statistical information of the Yearbook concerning international trade in agricultural products and concerning the agricultural production of all of the countries of the world for which information is obtainable. International trade tables are now compiled and published for corn, wheat, wheat flour, and for wheat and wheat flour combined in terms of bushels of wheat; for cotton, unmanufactured tobacco, hops, rice, sugar, tea, coffee, oil cake and oil-cake meal; for rosin, spirits of turpentine, india rubber, wood pulp, wool, hides and skins, butter, cheese, live meat animals, and packing-house products. There are twenty-two commodities for which tables of the international trade of most of the countries of the world are prepared.

The statement of the agricultural production of all countries ascertainable has been enlarged by the inclusion of several products heretofore omitted, and the full list of these products now embraces fifteen products, viz, corn, wheat, oats, barley, rye, potatoes, cotton, tobacco, hops, flaxseed, rice, sugar, cocoa, silk, and wool.

The compilation of the number of live stock for all countries for which the facts are known or estimated has been improved and expresses the best information concerning the number of cattle, dairy cows, horses, mules, swine, asses, sheep, domesticated buffaloes, camels, goats, and reindeer.

MEAT SUPPLY AND SURPLUS.

An investigation in relation to the meat supply and surplus of the United States was made, to determine, among other things, the meat production of this country and the per capita consumption, the importance of the meat industry as indicated by the capital directly concerned, the disposal of the national surplus of meat among importing countries during a long period of years, the stock of meat animals at census dates beginning with 1840, and the declining per capita consumption of meat.

In this investigation attention was given to meat consumption by workingmen's families, as determined by the Bureau of Labor; to the prices of meat and the consumer's cost of the meat consumed an-

nually. Much information was presented concerning the quantity of meat consumed in foreign countries. A specially full statement was prepared for Germany, made possible by the meat-inspection law of 1904.

This investigation made it possible to state the number of hides and skins produced in this country in 1900 and also the number of beef hides consumed in that year.

An investigation was also made of the restrictions against the importation of meat from the United States into principal European countries, which resulted in a summary of the prohibitions of principal European countries affecting pork, cattle, and beef, and of the restrictive measures which make the exportation of meat and meat products from the United States to these countries difficult, if not impossible, and of the technical procedures in exporting to those countries.

COMMENT ON CROP REPORTS.

During the year the Bureau and its reports have not been the subject of unfavorable comment and criticism, and it appears that the efforts which have been made to strengthen and improve the crop-reporting service have been productive of good results, which are appreciated by the country at large. Generally favorable and complimentary comments have been received from agricultural organizations in the South and throughout the country, who are appreciative of frankness, promptness, and accuracy in the preparation and publication of the reports.

THE LIBRARY.

The growth of the Library during the past year has been greater than that of previous years. It now contains 95,660 books and pamphlets relating to agriculture and kindred sciences and the subjects connected with the various activities of the Department. It is as far as is known the largest collection of agricultural literature not only in this country but in any country, and is indispensable in the work of the Department. The greater growth of the past year has been largely due to the increased number of publications received in exchange for the publications of the Department, especially from foreign countries. These exchanges form a very important part of the Library, without which the work of the Department would be seriously hampered.

During the past year 1,815 periodicals, exclusive of annual reports of societies and institutions, were received by the Library, and of this number nearly two-thirds were received by gift and exchange. In addition all the important current scientific works bearing upon the work of the Department are purchased, in so far as the funds of the

Library permit. The catalogue of the Library has grown till it now contains about 185,000 cards, forming a valuable key to agricultural and scientific literature.

With the cooperation of the Library of Congress, the Library of the Department has continued the printed catalogue cards for accessions to the Library, and the printed catalogue cards for Department publications, which have proved useful to many libraries. Although the main use of the Library is in connection with the work of the Department, it is in addition the National library of agriculture, and the aim is to extend its usefulness as widely as possible, first by the completeness of its collection, second by the printing of catalogue and index cards and the publishing of special subject lists, and third by the loan of its books to scientific workers connected with the various State colleges and experiment stations. During the past year books have been sent to twenty-nine different States, from Maine on the east to California on the west. Each year the extent and importance of the Library's collections are becoming better known, and the usefulness of the Library, not only to the Department but to agricultural scientists throughout the country, is shown to be steadily increasing.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The work of the Office of Experiment Stations in its relations with the agricultural experiment stations throughout the United States has been largely extended during the past year on account of its new duties connected with the administration of the act of Congress of March 16, 1906 (Adams Act). Never before has there been such a widespread and thorough discussion of the nature, requirements, and limitations of the different classes of work which our stations have undertaken for the benefit of agriculture. As a result, the organization of the stations has been greatly strengthened and a large amount of fundamental research has been inaugurated, while at the same time broader efforts have been made to reach and aid the masses of the farmers, both by publications and by practical demonstrations of improved methods. The great need and opportunity for fundamental investigations in agriculture have been brought out very definitely, and the wisdom of Congress in providing liberally for the endowment of such research by enactment of legislation of a permanent character has been abundantly shown. It is also more apparent that the more directly practical experiments and demonstrations which have been so popular in the past appeal strongly to local public sentiment and can be readily supported by State appropriations. The legislatures which have met during the past year have shown much liberality toward the stations, and it is evident that the increase

of National funds for these institutions will stimulate rather than retard State aid in their behalf.

The plans for the Adams fund work have been worked out with unusual care and deliberation, and, taken as a whole, they embody a large amount of investigation in the true sense, which will place agricultural science and research upon a higher plane. Considering the condition under which the first year's work had to be planned, the difficulty in securing men, the lack of uniform standards, and the diversity of views regarding what constitutes "original research" in agriculture, the programme must be regarded as very satisfactory. Not only has the amount of investigation greatly increased, but the outlining of the various undertakings in advance has also had the effect of systematizing the station work more thoroughly than ever before, and ultimately this should reflect favorably upon the activities of the station in other lines. If the system inaugurated for the Adams fund projects shall become more generally applied to the station work as a whole, it will be an important result of the first year's operations under the new act.

Together with the strengthening of the organization of the stations, there has been a clearer differentiation between their legitimate work and that of the colleges, farmers' institutes, and other educational agencies. In a considerable number of instances special officers have been provided whose main duties are in connection with the investigations under the Adams Act, and a number of stations are looking toward the provision of a staff for the station work, practically distinct from the teaching staff of the college. This better provision for the station work will increase its efficiency, prevent serious interruptions, and make the station more strictly an institution for experimentation and research in agriculture.

The lack of men is one of the most serious drawbacks to development in this line, and it is now realized that the question of human equipment is the most vital question before the experiment stations to-day. During the past year the pressure has become intense, resulting in many changes of men from one locality to another and often preventing stations from inaugurating new lines of work. The well-trained man competent to originate and conduct thorough and satisfactory investigations is the all-controlling factor of success in agricultural research. Without such workers generous funds and elaborate equipment become ineffectual. The present shortage of men is due in part to the development incident to the increased funds, but in large measure to the new standards which are being established for station work. These standards impose additional requirements and qualifications, and thus practically eliminate from consideration many who might formerly have been thought eligible for station positions.

We must look to the agricultural colleges to train more men for this important work and to inspire them with the proper spirit and point of view. This will necessitate a further differentiation of courses of study to meet the needs of agricultural scientists as contrasted with those of practical farmers. Not only must the standard of undergraduate courses be raised, but special graduate courses of the most thorough character must be provided. Otherwise the development of the experiment stations will be delayed and the agricultural interests of the country will suffer.

The institution of so much research of a higher order in connection with the agricultural colleges and experiment stations is already proving a strong inducement to men of a higher type to engage in this work, and more young men of the right caliber are taking advanced courses in branches relating to agriculture. As soon as it becomes evident that our stations will pursue a consistent and permanent policy with regard to higher research in agriculture we may confidently expect a great improvement in the personnel of their staffs.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

Each year now witnesses a great extension of the movement for the diffusion of agricultural education among the masses of our rural population. The National character of this movement has during the past year been conclusively attested by the passage by Congress of the Nelson amendment to the appropriation act for this Department for the fiscal year 1908, in which provision has been made both for extending the ordinary agricultural courses in our colleges and for the training of teachers of agriculture for the elementary schools. The celebration at Lansing, Mich., of the fiftieth anniversary of the beginning of agricultural education in this country marks an important step in the progress of the education of "the man who works with his hands." There have also been numerous local examples of the growth of this movement, notably the establishment of eleven agricultural high schools in Georgia, of single agricultural high schools in a number of States, and the enactment of permissive or mandatory legislation concerning agricultural high schools and the teaching of agriculture in the common schools in Texas, Michigan, and other States.

With every forward step in this movement greater demands for assistance are made upon this Department, and it becomes more clearly evident that in keeping with American custom in other lines some National agency is desirable to focus the experience gained in our several States and in other countries and, without exercising any control, but by diffusing information and stimulating local enterprise, to aid in systematizing and developing an efficient system of agricultural education throughout the length and breadth of our

land. Such work in agricultural education as this Department, through its Office of Experiment Stations, has attempted to do has been along these lines. During the past year that Office, under authority granted by Congress, has responded to demands for services extending over the entire range of agricultural education from graduate instruction to the most elementary forms of extension work. Representatives of that Office have visited the agricultural colleges, prepared upon request courses in agriculture for agricultural high schools in Georgia and Maryland, addressed important meetings in the interests of agricultural education, and assisted at county institutes in preparing teachers of elementary agriculture.

Cooperation with the Association of American Agricultural Colleges and Experiment Stations in matters relating to agricultural education has been continued. As chairman of the standing committee on instruction in agriculture, the Director of that Office has aided in preparing exercises and courses of instruction for elementary and secondary public schools. He has also consented to act as dean of the Graduate School of Agriculture during its third session, in 1908, at Cornell University, and begun to organize the faculty and work of that school.

As regards the subject-matter which is needed to form suitable courses of instruction in agriculture and to aid the teachers in elementary and secondary schools in adapting such courses to the requirements of different regions and different classes of students, the Office of Experiment Stations is in a position to render a service which it would be difficult for any other agency to perform. That Office regularly gathers and reviews practically all the literature on agricultural subjects issued by public and private institutions throughout the world. Out of the mass of material it now selects and abstracts for publication in the Experiment Station Record a few of the most important articles, but it could at comparatively little additional expense select and put in pedagogical form much more information that would be of very great service to teachers and students of agriculture in every State and Territory. If elementary and secondary instruction in agriculture is to be established in an effective manner and kept thoroughly alive and up to date our schools must regularly receive and utilize the new knowledge which the institutions for agricultural research and advancement are accumulating.

The information now issuing from so many sources and in so many languages and forms is at present almost wholly beyond the reach of the public school teacher. It must be worked over, selected, and published in usable form before the schools can effectually utilize it. No State agency is in position to perform such a service for the whole country, and it would therefore seem to be a proper function of the National Department of Agriculture and of that branch of this De-

partment which is most closely in touch with both research and educational institutions working along agricultural lines. At relatively small additional expense the value and effectiveness of the aid which this Department is now extending to agricultural education could be multiplied several times.

FARMERS' INSTITUTES.

The reports received from the State directors of farmers' institutes show that there has been a large increase in attendance during the past year. The total attendance was more than 1,500,000, exceeding by several hundred thousand that of the previous year. Special subject institutes are rapidly growing in favor. Most of the States have held special dairy, fruit-growing, corn-judging, and cattle-judging institutes. These meetings were devoted to a discussion of some one of these topics, were continued from two days to a week, and were conducted by expert instructors who gave practical demonstrations in connection with their lectures. Seven States held special institutes for women, and contests in growing corn, wheat, flowers, fruits, and vegetables have been instituted in a number of States to interest the farmers' children in the institute movement.

The movement for supplementing the farmers' institutes by the holding of short courses of instruction in special subjects at the agricultural colleges and in different agricultural districts is growing rapidly and already attempts are being made to organize and develop these movable schools. To aid this movement by showing definitely the character of courses of instruction which might be given on this plan this Office has arranged with agricultural experts for the preparation of a number of such courses.

In cooperation with the standing committee on extension work of the Association of American Agricultural Colleges and Experiment Stations, this Office has made an extended study of the agencies outside of the farmers' institutes which are engaged in diffusing agricultural education among our rural people. The results of this investigation have been embodied in reports of the committee of the association and have been published as circulars of this Office. It is evident that a broad field of usefulness is opening before the agricultural colleges in extending their work of instruction among the masses of agricultural people who can not attend the courses given at these colleges. They are now beginning to organize and develop an adequate system of extension work in agriculture. To aid them in this work they are calling on this Office for services which are entirely beyond our power to perform with our present force. Since the National Government is so fully committed to the policy of giving the States assistance in diffusing scientific and practical information on agricultural subjects among our rural people, it would seem a wise thing to provide the comparatively small fund needed to make this

Office an efficient clearing-house for this forward movement in agricultural education.

This Department and the agricultural colleges and experiment stations are doing a great work through their publications and courses of instruction, but as yet the masses of our farmers are only indirectly and superficially affected by the work of these institutions. Strenuous efforts and a broadly organized movement will be required to bring home to the masses of our farmers the results of exploration and research on their behalf. It is time that careful attention should be given to devising efficient ways and means for completing the great work of agricultural advancement to which both the Union and the States have committed themselves.

Foreign countries for many years have appreciated the importance of orally instructing rural people in agriculture. In addition to agricultural teaching in their universities, colleges, normal schools, academies, and secondary and common schools, numerous special classes of adults are organized in the country districts for instruction by itinerant methods. Professors of agriculture under Government direction are sent out to give instruction in the normal and rural schools, and to organize farmers' societies for the promotion of agriculture. Numerous agricultural high schools have been established, particularly in Denmark and Sweden, and are attended by large numbers of rural people of mature years. Demonstration fields showing the effects of various manures, methods of culture, and varieties of seeds upon crop production are found everywhere. More than 3,000 of these demonstration fields and farms are in operation in France alone.

Movable schools of agriculture form an important part of the educational system in all of these countries. They embrace schools of general agriculture, schools of forestry, horticulture, market gardening, apiculture, aviculture, dairy schools, poultry rearing, farriery, domestic science, and on other similar agricultural subjects. Expert advisers are employed by the State to visit individual farmers and give advice with regard to the methods of operation best adapted to their conditions. Universities and colleges are extending their activities to outlying communities, to farming people who are unable to leave their farms to attend classes at the collegiate centers. The practical results of the foreign system of agricultural research and education are shown in the increased production of these countries as compared with the United States, where the masses of the farmers have not been reached by organized educational agencies.

INSULAR STATIONS.

The experiment stations in Alaska, Hawaii, and Porto Rico have made pronounced progress during the year, and their efforts in the development and diversification of agriculture are beginning to be appreciated in their several communities.

The Alaska stations are devoting their efforts to live stock, horticultural crops, and cereal growing. In continuation of the policy of developing a station herd, there are now over 40 head of Galloway cattle divided between the Kenai Station and the newly established animal breeding station on Kodiak Island. The principal experiments at the central station at Sitka are along horticultural lines and plant breeding. As a result of the plant-breeding experiments, hybrids of strawberries, raspberries, and other small fruits have been produced and are under observation. These are the results of crossing some of the native hardy species with improved varieties. Cereal investigations and the production of forage are being given especial attention at both the Rampart and Copper Center stations. Winter wheat and winter rye and spring-sown wheat, rye, barley, and oats matured their crops at Rampart during the past season, as they have done every year since the establishment of the station in 1900. Some of the varieties of cereals ripened at Copper Center, several hundred miles farther south, but nearer the mountains. At both stations the production of grain hay has been shown possible. Work was begun this year at the station in the Tanana Valley near Fairbanks, and a considerable area was cleared and prepared for cultivation. The special agent in charge anticipates important results from the establishment of this station, as it is nearly in the center of a large area that is apparently capable of considerable agricultural development.

The Hawaii Station has continued its investigations along the lines of diversified agriculture, devoting especial attention to investigations on tobacco, rubber, rice, and honey and fruit shipments. That cigar tobacco of good type can be successfully grown in Hawaii has been proved. The rice investigations have already shown the possibility of greatly increasing the yield of that crop, and at the same time the expense of production may be reduced by the adoption of more modern methods of cultivating and handling the crop. The planting, cultivation, and tapping of rubber trees and the coagulation of the latex are being investigated, and promising results have already been obtained. The experiments in fruit shipment have been continued, and it has been shown possible to land Hawaiian pineapples and avocados in Chicago in excellent condition. These investigations are of great economic importance to Hawaii, as they show the possibility of supplying the markets of the western portion of the United States with tropical fruits. Studies have been made that lead to a better understanding of Hawaiian honeys, which will possibly result in an enlarged market for that important product.

The Porto Rico Station is giving its attention to problems of soil management, crop rotation, methods of cultivation and improvement, horticultural problems in connection with citrus and other fruits, pineapples, etc. Following the successful efforts of the sta-

tion in shipping pineapples to New York and other markets, large quantities of the more desirable varieties are now being exported. The station is carrying on cooperative work with planters along a number of lines, and the results of these efforts are beginning to be seen in the adoption of improved methods of crop production. The coffee experiments have been especially valuable, and if the economic conditions relating to the marketing of the crop should be changed, the suggestions given regarding planting, fertilizing, cultivation, pruning, and shading will be widely adopted. The collections of economic plants are being extended, and the horticulturist reports the successful introduction of a considerable number of varieties of European and American grapes. The entomologist has devoted much of his time during the past year to combating the insects occurring on citrus and other trees, and reports the discovery of a very active parasite on the eggs of the tobacco horn worm. It is believed that this parasite can be successfully utilized.

The stations are all developing quite rapidly, and for their proper support I recommend for them appropriations equal to the amounts given each of the State stations under the Hatch and Adams acts.

NUTRITION INVESTIGATIONS.

The nutrition investigations, carried on under the auspices of the Office of Experiment Stations, were undertaken primarily to learn the nutritive and economic value of agricultural products of animal and vegetable origin used as food for man. In carrying on the work during the past year it has been the policy, as in the past, to cooperate with agricultural experiment stations, agricultural colleges, universities, and other institutions in different States and Territories, and to establish centers of investigation wherever an institution or region offered special facilities. Thus, cereals and cereal products have been studied at the Maine and Minnesota agricultural experiment stations, the nutritive value of fruit and nuts at the California Experiment Station, and the nutritive value of cheese at Middletown, Conn., and the Minnesota Experiment Station. In this way the Department funds have been materially supplemented by the contributions of the cooperating institutions and the results obtained have been large in proportion to the outlay. New experiments have been undertaken whenever the completion of any line of work has rendered this possible, and the enterprise as a whole has been systematized and grouped as a series of projects in accordance with the general plan for the work of the Department of Agriculture.

The Washington office has been responsible for the plans for the work as a whole, for the editing of the results, and the distribution of information, as well as for some special investigations.

The experiments at the California Agricultural Experiment Station have demonstrated the comparatively thorough digestion of fruits and nuts of different sorts and the nutritive value of these important crops and their value as foods rather than food accessories.

At Middletown, Conn., the results of respiration-calorimeter experiments have been prepared for publication on the subjects of muscular and mental work as related to energy income and outgo and the demands of the body for food. From the elaborate experiments reported it does not appear that mental work exercises a positive influence on metabolic activity—that is, on the amount of oxygen consumed and carbon dioxid and energy given off from the body—nor does it modify the body demands for nutrients and energy. Muscular work, on the other hand, is absolutely dependent on the energy supplied by the food or material stored in the body from previous food supply. The total energy output, which may be readily determined with the respiration calorimeter, is a definite measure of the total work performed by the body, and hence of the amount of energy which the food must supply for the performance of a given kind and amount of work. In other words, it is possible to determine with the respiration calorimeter energy requirements as expressed in dietary standards.

Man's efficiency as a machine for the performance of work has been studied in connection with the respiration-calorimeter experiments and found to be 21 per cent in round numbers, or much higher than that of even the most perfect engine.

In accordance with the action taken by Congress at its last session, the respiration calorimeter and accessory apparatus have been brought from Middletown, Conn., to Washington and stored.

The experiments on the digestibility and nutritive value of different kinds of cheese, carried on at the Minnesota Agricultural Experiment Station, supplement earlier work of this character at Middletown, Conn., confirm the results obtained, and materially extend the conclusions reached. As shown by the large number of digestion experiments with healthy men, cheese, both the ordinary American Cheddar and other sorts studied, is on an average very thoroughly digested without physiological disturbance and compares favorably with other staple foods as a source of nutrients and energy. In other words, cheese is to be regarded as a food for use in quantity when desirable or convenient rather than as a condiment for occasional use.

At the University of Illinois the experiments on the effects of different methods of cooking on the nutritive value and digestibility of meat of different kinds and cuts have been continued. The conclusion reached is that meats of all kinds are to be ranked among the very digestible foods. No marked difference was observed in either the ease or thoroughness of digestion of different kinds or cuts.

Experiments on domestic canning and preserving of vegetables have been continued at Wellesley College, Massachusetts, and as a result of this inquiry and earlier work satisfactory methods have been devised and await publication.

The studies at the University of Chicago of the changes brought about in cooking fruits and the effects of different methods on the yield and quality of the cooked product have furnished valuable data applicable in domestic jelly and jam making.

At the Maine Agricultural Experiment Station investigations regarding the digestibility and nutritive value of different sorts of corn meal prepared for the table in a variety of ways have been continued, and the work as a whole has demonstrated the high nutritive value of this important cereal crop and shown the reasonableness of its use in quantity as an integral part of the diet.

The studies of the effects of different methods of grinding on culinary quality, which have been made at Teachers' College, Columbia University, New York, have made it plain that by suitable methods of manipulation in cooking it is possible to obtain uniform results with both old water-ground and new-process meal.

As a result of the extended work on corn a Farmers' Bulletin has been prepared, summarizing available data on the use of this cereal as food.

As regards the digestion, assimilation, and nutritive value of flour products other than bread, the investigations which have been carried on at the Minnesota Agricultural Experiment Station, in continuation of earlier work on cereal foods, show that such goods closely resemble bread in their digestibility and that the various methods of handling flour in cooking and the combining with it of other foods, as shortening, do not materially affect the proportion which is digested.

At Columbia University, New York, studies on the ash content of foods have been continued, and a bulletin has been prepared setting forth the results obtained with calcium, magnesium, and phosphorus.

Cooperating with Drexel Institute, Philadelphia, dietary studies have been made in a home for aged women and an orphan asylum. It is proposed to incorporate the results with those of similar work carried on in Baltimore institutions as a contribution to the question of dietetics in relation to institution management. The results also supply valuable information regarding food requirements in early youth and old age as compared with the period of full vigor.

Studies of the pedagogics of nutrition have been continued, especially in cooperation with Teachers' College, Columbia University, New York, and a large amount of data has been collected and systematized regarding the higher courses in domestic science which are given in American agricultural colleges, universities, normal schools,

and kindred institutions. The total number at present on record which give such courses is 150, of which one-third are institutions receiving Government aid. The courses vary decidedly in scope and extent, but the importance which the subject of home economics is assuming in modern education is very apparent from the data available. The nutritive value of food is one of the important subjects included in such courses, and in these institutions, as well as in medical colleges, Department nutrition publications are very commonly used as text-books, owing to the fact that other satisfactory reference works on the subject have not hitherto been available. These publications are also largely used in the numerous secondary and elementary schools where courses on foods and cooking are given.

The results of the nutrition investigations are made public by means of technical bulletins and popular summaries, and in addition a great deal of miscellaneous information is supplied to teachers, students, and other persons by means of correspondence, the increasing demand for publications and other data being an indication of the favorable way in which the work is regarded by the people at large.

The problems concerned with the rational and economical utilization of agricultural products as human food are so intimately and vitally related to those connected with the production of the food stuffs on the farm that the nutrition investigations may well be a part of the work of this Department. The experimental methods which have been elaborated and the lines of work which have been followed in the nutrition investigations are well fitted to supply the information which is needed in order to utilize in a satisfactory way the available food supply in the proper and economical feeding of families and groups. In view of the demonstrated usefulness of this work and the large demand for information along these lines, especially for use in connection with our public and private schools, where the scope of instruction relating directly to home life of our people is being steadily enlarged, I earnestly recommend that provision be made for the continuance of these investigations. A place has been provided in the new Department building for the respiration calorimeter, and it will be possible there to continue the fundamental researches which are required to put our knowledge of the utilization of food in the body on a thoroughly scientific basis.

IRRIGATION AND DRAINAGE INVESTIGATIONS.

Recently the chief of irrigation and drainage investigations has accepted an invitation of the Australian government to take the supervision of the work in irrigation which that government is about to undertake for the benefit of agriculture in that country, and has withdrawn from the service of this Department. This has opened the way for a reorganization of our irrigation and drainage investi-

gations, which seemed advisable in view of the present extent of this enterprise and a quite distinct differentiation of the irrigation work from that in drainage, both as regards the character of the projects and the regions in which they are carried on.

IRRIGATION INVESTIGATIONS.

The work of this Department in irrigation divides itself into three geographical divisions, each with its own peculiar problems: The older irrigated sections, where the irrigated area has been extended to the limit of the water supply and where economy in water is the most pressing necessity; the section just brought under ditch, where water is plentiful for the present and where the prevention of waste of labor and money by the settler in bringing the land under cultivation is a condition of success; and the sections where farming has been carried on without irrigation but where droughts occur with sufficient frequency to make success doubtful, or where raising prices or soil exhaustion makes more intensive farming necessary.

The work in the older sections consists of experiments to determine the losses of water under ordinary practice and how these losses may be prevented. Water is lost by seepage from ditches, by evaporation from water surfaces and from the wet soil, by percolation beyond the reach of plants, and by waste which may seem necessary to properly wet the soil. We are making experiments to find cheap and effective ditch linings to prevent seepage losses, which in many instances are more than 50 per cent of the water entering the ditches. We have made experiments to determine the losses by evaporation and the effectiveness of different methods of applying water and cultivating the soil after irrigation in checking these losses, the results showing that half the water lost in this way can be saved. We have made observations to determine how far the water applied by different methods to different types of soil penetrates into the soil for the purpose of adapting methods of applying water to soil conditions in such a way that proper moisture conditions may be maintained without loss by percolation beyond the reach of plant roots or by surface run-off.

During the past five years construction of irrigation works has outrun settlement. During that time the Government has expended $40,000,000 in irrigation construction, and private parties at least an equal amount. A canvass recently made indicated that as a result of this activity there would be at least 5,000,000 acres of unreclaimed land provided with a water supply ready for settlement in 1908. The cost of preparing this land for irrigation and providing the equipment for successful farming will be fully as great as the cost of building the canals to bring water to it, so that when the canals are built the work of reclamation is but half done. The safety of this whole

investment in irrigation works and in the preparation of land for use, and, what is much more important, the safety of thousands of future homes, depend upon the use of proper methods both in the preparation of the land and in the subsequent use of water. The cost of the irrigation works, whether they are built by the Government or by private parties, must be repaid by the settlers, and their success or failure means success or failure for the projects. These settlers must come largely from sections where irrigation is not practiced, and will be unfamiliar with the use of water. Mistakes in the preparation of the land and in the adoption of methods of applying water are costly not only in the time and labor lost, but also in decreasing crop returns, and, in addition, they come at a critical time, when payments for land, water, implements, stock, and food are all pressing. It is our endeavor to aid the settlers at this crucial time by telling them how to do the work with the least expenditure of time and money, and in such a way as to get the best results. This is done through bulletins, the giving of practical directions through personal advice by the more experienced of our field men, and through demonstration farms established under cooperative agreements with local parties, with State experiment stations, and with the Reclamation Service of the Department of the Interior.

In the semiarid region the four irrigation extension farms established last year have been maintained. Each is situated where no large supply of water is available and where most of the land must be farmed without irrigation. These stations are to determine and demonstrate the possibilities and cost of irrigation with the small water supplies which can be made available in these regions in the hope that the irrigation of a small area in connection with the use of drought-resistant crops and intensive cultivation on a much larger area may enable settlers to successfully maintain homes on the high plains, which otherwise must be devoted to grazing only.

The rush of settlement in this region in the past few years is in many respects similar to previous waves which have swept over it, and many have feared a repetition of the former disasters which wrecked so many homes and lives. It is to guard against this that we are making every effort to provide the settler with a means of pulling himself through the years of drought, while looking to the wet years for his profit.

It is our belief that irrigation may profitably be extended into other sections where it has not been considered necessary. We are this year carrying on experiments to determine this in the Willamette Valley in Oregon and in the Sacramento Valley in California, while we have maintained an experiment as far east as Iowa. Previous experiments have shown that irrigation is profitable as a crop insurance, even in the extreme East, and a knowledge of its possibilities

and methods will lead to its extension in the future, until it will be practiced to some extent throughout the United States.

In many places where irrigation is now practiced water is secured by pumping, and the extension of irrigation into many sections will depend upon the ability to secure water in this way cheaply. The use of power in irrigation and drainage is made a part of our work, and we have made many tests of pumps, engines, and windmills, in order to be able to answer the inquiries received from those wishing to pump water for irrigation. These tests show efficiencies of the pumping machinery varying from 5 to 80 per cent, thus demonstrating the great need which our farmers have of accurate information on which to base their purchases of machinery suited to their purposes.

DRAINAGE INVESTIGATIONS.

This line of work has developed and expanded more rapidly during the last year than ever before. The demands for information, assistance, and advice in relation to the drainage of agricultural lands in all sections of the country have been so numerous that it has been beyond the physical possibilities of the available office and field force to comply with all the requests, and it has hence been necessary to postpone compliance with many meritorious applications for assistance.

The drainage work has been carried on along the following well-established lines:

(1) The examination, study, and comparison of past and current drainage practice as developed under differing conditions in various sections of this country and abroad, with special reference to determining the success or failure of the various methods attempted in solving the problems of agricultural drainage, and the efficiency or inadequacy of the various systems for use in those localities where drainage is an important factor in agricultural development. The information thus collected is arranged, systematized, and issued in bulletin form as rapidly as practicable, with the object of furnishing to the public generally, and especially to agricultural engineers and those charged with the responsibility of the successful carrying out of drainage enterprises, a comprehensive, reliable, and up-to-date body of knowledge covering the scientific bases upon which all successful drainage work must rest, and an epitome of the best practice as developed under recent conditions. It is the intention thus ultimately to have a complete compendium of the knowledge necessary for the planning and execution of drainage work under all the great variety of diverse conditions which obtain in the different portions of this country—knowledge which now does not exist in any available printed form and the lack of which is responsible for a large portion

of the requests for information which now come to this Office from engineers and technically educated men.

(2) Assisting farmers, communities, and States in the initiation and direction of drainage improvements. It has been the unfortunate experience of most localities requiring drainage that a large portion of the first attempts to secure needed improvements have resulted in failure. Such attempts resulting in total or partial failure not only entail the involved financial loss and delay, but have tended greatly to discourage and render more difficult the prosecution of other meritorious enterprises. Nevertheless, out of such a history of numerous failures and difficulties in accomplishing adequate drainage many communities in those States where drainage has been satisfactorily accomplished for many years have evolved from a state of unhealthfulness and poverty to a condition of unrivaled prosperity. It is with the hope of preventing expensive mistakes and avoiding exasperating delays, with their attendant discouragements, that this Office assists in the inauguration of drainage projects. This assistance is given most fully in those States and localities where drainage is a new feature, so that the results of previous similar local work are not available as a guide and example. The most common errors in the preparation of plans for drainage arise from a lack of the technical knowledge requisite to secure good engineering design, and from a want of appreciation on the part of those undertaking the work of the size and extent of work necessary to secure the desired effects. In these matters this Department is in position, by the experience and standing of its staff, to give advice which carries such weight as to settle local differences of opinion and promote the cooperation of all the parties at interest.

(3) Examinations and experiments relating to such technical problems pertaining to land drainage as to which there is at present a lack of existing knowledge. These investigations include a study of the drainage coefficient of agricultural lands of different types, the relation of flood run-off to different climates and kinds of topography, systems for draining muck lands which border on peat formation, the movement and behavior of water in irrigated land, the laws of erosion of ditches and of the sedimentation of ditches, tests of the best methods of making, handling, and using cement drain tile, and similar questions. As an illustration of this kind of experimental work, the Office is now conducting experiments as to the efficiency of the use of drain tile in the far North, where the ground freezes to a depth of 6 feet or more in the winter; in the sticky and impervious gumbo soils of the southern Mississippi delta region; and in the exceedingly fine volcanic ash soils of the irrigated Rocky Mountain region.

The operations of the drainage investigations have included work during the past year in about two-thirds of the States of the Union. The survey of the Kankakee Valley project in Indiana was completed and a report embodying the results of three years' investigation was prepared and transmitted to the local authorities. Nearly half a million acres in this valley were once a marshy plain. During the last twenty years numerous small projects for the improvement of the drainage of separate portions of the upper end of the valley and areas along its outer margins, by means of straightening, cleaning, and deepening parts of the channel of the river and its tributaries, have been successfully completed. In this way large areas have been rendered available for profitable agriculture. At the time this Office took up the work local jealousies and differences of opinion had reached such a state that it seemed impossible for the various interests to reach an agreement which would lead to the relief and improvement of the large and important areas embraced in the main lower part of the valley.

As a result of the careful surveys and studies by the engineers of this Office a comprehensive plan was prepared in this Office for increasing the carrying capacity of the lower portion of the river channel by shortening its length from 72 miles to 42 miles. This is accomplished by cutting off 84 bends of the present stream by cuts varying from 150 to 5,500 feet in length. The excavation of this channel will require the removal of nearly 10,000,000 cubic yards of earth and will cost approximately $1,000,000. This improvement involves six counties in Indiana and one in Illinois. Probably 500,000 acres of land will be directly benefited. The value of these improvements can scarcely be estimated, although similar land in Indiana has risen in value from $5 to $100 per acre after drainage.

During the winter of 1906–7 a preliminary survey was made of a part of the Everglades of Florida, an area of swamp land covering some 5,000 square miles. A line of levels was run from Fort Myers, on the Gulf coast, across the glades south of Lake Okeechobee to the Atlantic coast, connecting on the way with the surface of Lake Okeechobee. This survey was made in the face of great physical difficulties, it being necessary for the men engaged to carry all their supplies for a distance approximating nearly 50 miles through soft muck, with the aid of canoes for only part of the way. This was the first time that a survey had ever been carried across the region, although there had been numerous previous attempts. The results so far attained encourage the hope that the further investigations which will be made will prove the practicability of reclaiming profitably for agricultural use a large area of this land, which is now too wet to be successfully cultivated and is hence practically worthless.

Surveys of the lowland subject to injury by overflow lying along the Red River of the North in North Dakota were concluded in Pembina County, thus completing the project previously begun and embracing also Cass, Traill, Grand Forks, and Walsh counties. The total area surveyed was about 3,000 square miles. Plans and estimates were prepared for drains for this entire area. The work was carried out under a cooperative agreement among the counties interested, the State engineer's office of North Dakota, and this Office. The report has been printed and submitted to the local authorities.

The field work was completed and plans prepared and submitted to the people for improving the Neosho River in southeastern Kansas. The watershed drained by this stream embraced 5,090 square miles and the plans provide for the protection of 161,000 acres of overflowed land, at an average cost of $9 per acre. It is generally conceded that the loss and damage from the overflow in 1904 were more than the estimated cost of protecting these lands. The report discusses fully the engineering problems involved, and the accompanying maps give the elevation of the overflowed lands and the profile and cross section of the stream and the details of the proposed improvement.

Much attention has been given to the possibilities of drainage in the Delta region of the lower Mississippi Valley. A very active interest has recently developed in drainage in this region. In Arkansas, Louisiana, Mississippi, and Missouri there is a constantly growing agitation of the matter. The completeness of the levee system is now rendering safe the expenditure of large sums for the improvement of the low flat lands formerly subject to overflow by the Mississippi floods. This Office has made preliminary examinations of large portions of this region and has so far as means were available assisted in the organization and plans for actual drainage construction for definite limited areas.

The problem of the reclamation of the swamp tide lands along the Atlantic coast has been frequently urged upon this Office, and has received special attention during the last year. Special examinations have been made in various localities, advice has been given, plans have been prepared, and publications have been issued devoted to this phase of drainage. Experiments to determine the best methods for the removal of excess seepage water and accumulated alkali from the irrigated regions in the West have been continued.

Gratifying reports have come to the Department from localities where the drainage plans, prepared in previous years, have been put into execution, showing the great benefits which have accrued to farmers who have carried out the advice given by this Office. During the last fiscal year plans were prepared for the drainage of about 2,000,000 acres.

OFFICE OF PUBLIC ROADS.

It is the province of the Office of Public Roads to investigate the various conditions affecting the public roads and to ascertain and make known the remedies for the evils in existing systems and methods of road construction and administration. During the past year the work of the Office was divided into twenty-two projects, dealing with practically every subject of interest in connection with wagon roads. This represents a greater number of projects than have been undertaken in any single previous year.

ROAD MILEAGE, REVENUES, AND EXPENDITURES.

The close of the year marked the completion of the first census ever made to determine the road mileage, revenues, and expenditures in this country. This investigation was begun early in 1905. Information covering the calendar year 1904 was obtained from carefully selected correspondents in every county in the United States, from State highway departments, State geologists, city and county officials, employees of the Office of Public Roads on field duty, commercial and agricultural associations, and newspapers—in fact, every possible source of information was used. In some of the States reports were made by townships. While these reports are in some cases incomplete, the greatest care has been taken in their verification, and the results as a whole are reasonably accurate. The bulletin recently issued on this subject shows the enormous total of nearly 2,152,000 miles of public road; that 7.14 per cent of this mileage has been improved, and that the total expenditure for 1904 was approximately $80,000,000. Considering the fact that our improved roads have been in process of construction for a number of years, it becomes evident that the results which we are obtaining are totally inadequate to the amount of money expended, and that the mileage is so great that we must of necessity classify our roads according to their importance, bearing in mind the fact that by far the largest proportion of our earth roads must be maintained as such for many years to come.

METHODS OF ROAD CONSTRUCTION AND MAINTENANCE.

The construction of object-lesson roads in cooperation with local authorities was continued during the year along the same lines as in previous years, excepting that greater attention was given to the building of earth, sand-clay, and gravel roads. In every case the local authorities furnished common labor, materials, teams, and fuel. The engineers of the Office of Public Roads were instructed to ascertain in their preliminary work as accurately as possible the character of construction best suited to the locality, and under no circumstances to recommend the building of a road which, though excellent in

itself, might represent a form of construction ill suited to the locality or too costly to be continued. Sixteen roads were completed during the year, representing a total of 200,711 square yards, which is far greater than the amount completed in any preceding year. The work of construction was supplemented when practicable by informal lectures, explaining the methods used in building the object-lesson roads.

The endeavor has been made to reduce the cost of construction to the lowest point consistent with efficiency, recognizing the fact that the cost of building improved roads is the chief obstacle in the way of their general adoption. The cost of macadam in a road built at Williamsburg, Va., was only 36.3 cents per square yard, or at the rate of $2,556.22 per mile, exclusive of engineering assistance and machinery furnished by the Office.

Work on the object-lesson roads was carried on during the year in Alabama, Arkansas, the District of Columbia, Kansas, Kentucky, Louisiana, Maryland, Montana, Nebraska, North Carolina, Oregon, Tennessee, Virginia, and Washington.

A bulletin on the construction of macadam roads, based upon the best practice in the States which have made the greatest progress in macadam road building, was issued during the year. Earlier studies of sand-clay and burnt-clay construction showed these to be valuable methods in those sections of country where hard materials are lacking.

The mixing of sand and clay has long been recognized as an effective method of road construction. The burning of clay for railroad ballast was begun some years ago, but its adaptability to road building has only been made known by this Office in recent years.

Experiments in the use of burnt clay as a road material at various points in Mississippi give most favorable indications of success, and it seems quite probable that a long step forward has been taken in solving the road problem in the Mississippi Delta.

The maintenance of earth roads has received special consideration, and an expert in the construction and use of the split-log drag has been employed to aid in the general introduction of this simple and effective means for bettering earth roads.

Many failures in road building are due not so much to a general disregard of standard methods of construction as to serious mistakes in some particular feature of the work. For instance, the cost of quarrying the stone may be excessive through ignorance of the best practice; the road may prove unsatisfactory because of a poor location or on account of the use of inferior material. In all such cases expert examination and advice will go far toward enabling the local road officials to remove the difficulty. During the past year about forty such assignments were made from the Office of Public Roads. In one county in Alabama a strong movement was on foot to issue

bonds for a large amount for the purpose of building macadam roads. An engineer detailed from this Office upon request ascertained that the conditions were satisfactory for building sand-clay roads and very poor for building macadam roads, the material for the latter being inaccessible except at great cost. He advised the building of sand-clay roads. His advice was followed, and to-day that county has 118 miles of road built at a cost of $22,000 which meet the requirements of traffic practically as well as macadam roads would do.

LECTURES.

The trend of public opinion with reference to our public roads is indicated by the requests which have been received during the past year for the detail of men to lecture on road improvement. In former years the demand for lectures on road improvement came largely from road organizations, but during the past year requests have been received from agricultural, industrial, scientific, and commercial organizations which are taking up the subject. These requests have been complied with as fully as possible, and the most careful effort has been made in all cases to confine the lectures to practical topics, and to give information and advice based upon actual experience and careful study of the subject. In all, about 150 lectures were given during the year.

INSTRUCTION IN HIGHWAY ENGINEERING.

The plan of appointing graduates of engineering schools to the position of civil engineer student in the Office of Public Roads has been continued during the past year with marked success. The necessity for competent highway engineers to direct the work of road building along proper lines has become increasingly apparent in recent years. The remarkable success of the French road system is largely due to the fact that the Government maintains a school of roads and bridges, from the graduates of which is recruited a thoroughly efficient corps of highway engineers. The course of training given in the Office of Public Roads of this Department covers a period of only one year, but instruction even to this extent is beneficial to the student, the public service, and the city, county, or State which eventually employs the young man receiving such instruction. Six students were appointed during the past fiscal year, making a total of fifteen since the inauguration of this project.

A plan for introducing more thorough and practical courses in highway engineering in the various schools and colleges was put in operation during the past year, whereby engineers of the Office of Public Roads are detailed for a series of lectures on highway engineering at some time during the regular school year.

INVESTIGATION OF THE PROPERTIES OF ROAD MATERIALS.

The total number of road-material samples received for testing during the year was 405, as compared with 384 for the preceding year. The greater number of samples were received from State geologists and State highway commissions, a gratifying fact, since it insures the best disposition of the data obtained in the Office of Public Roads. The State geologists of Maryland, Massachusetts, Montana, and New Jersey, and the highway commissions of Connecticut, Massachusetts, Minnesota, Ohio, Pennsylvania, Rhode Island, and Virginia cooperated in this manner.

During the year progress was made in the design of special equipment for conducting road-material tests. The most important addition to such equipment was a new impact machine for testing the toughness of road-building rock. In July, 1906, specifications developed in the Office of Public Roads for determining the toughness of rock for road building were submitted to the American Society for Testing Materials and adopted by that society.

As a result of the petrographic examination of rocks used in road making, a classification of such rocks has been made and facts of importance gained bearing on the relation of the physical properties of rocks to their mineral composition and structure.

SPECIAL INVESTIGATIONS.

I desire to call special attention to the investigation relative to the corrosion of iron. This investigation, begun in connection with the subject of metal culverts and fence wire, has produced results of far-reaching importance. It has demonstrated that the generally accepted theory regarding the oxidation of iron is incorrect, and that by treating the surface of iron with a strong oxidizing agent the rusting can be inhibited so long as the oxidizing agent is present.

Experiments conducted for several years relative to the decomposition of rock powders have also led to valuable results. A fact of great importance in road construction established by this investigation is that a better bonded surface for roads can be secured by mixing rocks such as limestone with the more siliceous crystalline rocks. This work has led to a more extended investigation relating to the extraction of potash from feldspathic rocks. Reference has been made to this work in previous reports, and it has been described in several bulletins. It seems probable that these studies will develop a method commercially practicable for extracting potash from feldspathic rocks. If this is done our dependence upon foreign sources of supply for potash will be decreased, at least to a certain extent.

COOPERATION WITH DEPARTMENTS AND BUREAUS.

During the past year more than thirty rural-delivery roads were inspected, in cooperation with the Post-Office Department, at a cost

of only about $950 to this Department. Much improvement has resulted from these inspections.

Between August 17 and October 14, 1906, an engineer from the Office of Public Roads made an investigation of the roads and trails in the Yellowstone National Forest upon request of the Forest Service. A report containing recommendations and estimates was prepared and submitted to the Forester.

The Department cooperated with the Navy Department in the construction of a shell road at the New Orleans naval station; with the War Department in experiments with dust preventives, and with the Geological Survey in designating on topographic maps the character of the roads shown.

INVESTIGATION OF ROAD MATERIALS IN THE SEVERAL STATES.

Previous to the past fiscal year no personal investigation of road materials in the several States had ever been made, owing to the magnitude of the work and lack of appropriation. Last year, however, a cooperative arrangement was entered into whereby the State highway commissioner of Minnesota was made a special agent of the Office and assigned to the work of investigating the road materials in that State. This work will be completed during the present calendar year. It is intended that such an investigation shall be conducted in each of the States as rapidly as facilities will permit. This investigation is designed to ascertain the location, character, quality, quantity, and accessibility of all road materials in the respective States, cost of transportation by rail, by water, and by wagon, suggestions for possible methods of quarrying, probable markets for material, feasibility of using convict labor in the preparation of material, and other essential points.

MODEL COUNTY SYSTEMS.

The roads of a county should be built according to a predetermined and unified system, based upon a most careful investigation of materials, amount of traffic, revenue available, methods of construction adapted to local needs, organization and administration, and all factors entering directly or indirectly into the road work. A plan was inaugurated during the past year whereby the most competent engineers of the Office of Public Roads were assigned, upon request of county authorities, to make such an investigation and to prepare for the future use of the county road authorities an exhaustive and detailed report with plans, estimates, and recommendations indicating the location of all materials, advising which should be used, indicating the roads that should be improved and the method and cost of improvement suggested, needed changes in organization and in methods of administration, and in short affording a guide for future county road work.

The first assignment of this character was made at Santa Barbara, Cal., followed by work of a similar character in Los Angeles County. The success of this work has been recognized, and Los Angeles County is now proceeding under recommendations made by the engineer of this Department.

INVESTIGATION OF DUST PREVENTIVES AND ROAD PRESERVATIVES.

In recent years perhaps the most important and certainly the most difficult problem which has engaged the attention of highway engineers is the prevention of dust. Until the general introduction of motor vehicles dust was considered as neither more nor less than a nuisance. The problem has now, however, assumed a more serious aspect. The existence of our macadam roads depends upon the retention of the rock dust formed by the wearing of the surface. Under ordinary traffic conditions this dust remains on the road and consolidates to form a fresh wearing surface. But a heavy rubber-tired automobile moving at a high rate of speed produces a partial vacuum behind each wheel which sucks up the dust from the road surface and throws it into the air to be carried off by the wind. This action soon strips the macadam road of all fine material, the result being that it soon disintegrates.

France, both by reason of her large mileage of macadam roads and the general use of automobiles, has given this subject the earliest and most thorough consideration. Investigations and experiments have also been conducted in England, and to some extent in this country. During the past year a thorough investigation was made of the systems in use both in France and England. Experiments with tar and oil were conducted during the past summer in Kentucky and Massachusetts with a number of materials and preparations designed to preserve macadam road surfaces.

This is a subject which should engage the earnest attention of the National Government at once. No matter how important we may deem the building of good roads, we can not but consider it even more important to preserve those which have already been constructed. Investigations of dust preventives and road preservatives will be conducted by the Office of Public Roads during this and the next fiscal year as far as its facilities will permit.

THE DEPARTMENT'S WORKING FORCE.

The report of the Appointment Clerk shows that there were on the rolls of the Department at the close of the fiscal year 9,107 employees. Of the entire force, 1,972 were employed in the District of Columbia and 7,135 outside of the District.

The following figures are sufficient to show the growth of the Department during the past forty years: In 1867 the total number of

persons employed in the Department was 99; in 1877 the total number was 77; in 1887 there were 328 employees; by 1897 the number had increased to 2,444; and on July 1, 1907, the total number of persons employed had reached 9,107.

OFFICE OF THE SOLICITOR.

Questions affecting the operations of the Department under the statutes committed to it for execution were frequently referred to the Solicitor during the year for written or oral opinions, and several important confidential investigations of a quasi-legal character were conducted under the direction of the Secretary. The correspondence connected with the enforcement of the twenty-eight-hour law is very voluminous. There were 677 cases under this law transmitted to the Department of Justice during the year. Eight cases under the Lacey Act (act of May 25, 1900) regulating interstate commerce in game were reported to the Department of Justice. The Department secured a conviction in the only case reported under the act of June 28, 1906, prohibiting trespass upon the bird reserves set apart for its use by orders of the President. Recovery of property of the Weather Bureau withheld by former employees was effected through the Solicitor in the three cases reported by the Bureau. In a number of cases pending in the Court of Claims at the close of the year the Solicitor assisted the special attorneys for the Government in procuring the evidence and preparing the papers. During the year the Department secured a conviction under the cattle quarantine law (act of May 29, 1884), and reported a number of cases to the Department of Justice, which are now pending. Under the cattle quarantine act of March 3, 1905, three convictions were secured in cases reported by the Department. Several others are pending. In addition to these cases there were 215 complaints against railroads for violation of the regulations of the Department governing the placarding of cars in interstate shipment of cattle from quarantined area investigated by the Solicitor and taken up by him with the respective railroads with a view to securing a rigid compliance with the regulations in the future. The meat inspection amendment of June 30, 1906, went into force in October of that year. One case had been reported to the Department of Justice before the close of the fiscal year. In December the Department secured the conviction of a man who attempted to bribe a live-stock inspector, and he was fined $300 and sentenced to ten days in jail. The meat-inspection amendment of June 30, 1906, imposes upon the Secretary the duty of prescribing regulations for its enforcement. In this work the Solicitor rendered assistance, as well also as in the preparation of the decisions announced by the Department in its interpretation of the food and drugs act. Three patents for Department employees were procured during the year, and others

applied for. The Solicitor is one of the three members of the Board of Food and Drug Inspection, in which capacity much of his time is spent. He is likewise a member of the committee on personnel of the Department for the investigation of all serious delinquencies occurring among the employees thereof.

NEW BUILDING FOR THE DEPARTMENT.

The work on the new building for the Department has progressed satisfactorily during the year, and it is hoped to occupy the new quarters within the next month or two. As pointed out in my last report, in considering the question of a building, the imperative need for suitable laboratories to carry on the important investigations of the various bureaus and fireproof space for the Library was recognized as paramount. The greater part of the indoor work of the Department is conducted in laboratories, hence the absolute necessity for structures that would be well lighted, well ventilated, fireproof, and otherwise well adapted for the purpose. To accomplish these several objects and at the same time to secure opportunities for continued enlargement, the building has been arranged so that extensions can be made in segments as the work requires.

When the act authorizing the building was passed we could not foresee the rapid growth, by Congressional action, of the Department. On February 3, 1903, when the work was authorized, there were in Washington 1,100 persons employed in the Department of Agriculture. At the present time there are over 2,100—almost double the number on the date when the appropriation was made.

While the original appropriation was so expended as to secure the greatest possible amount of floor space, this floor space is now totally inadequate to care for the increase of almost 100 per cent in the number of employees. Full arrangements have been worked out for the occupancy of the present segments and the relinquishment of the several buildings for which rent is now being paid. The work will be completed within the appropriation made by Congress.

Respectfully submitted.

James Wilson,
Secretary of Agriculture.

Washington, D. C.,
November 23, 1907.

PROGRESS IN SOME OF THE NEW WORK OF THE BUREAU OF PLANT INDUSTRY.

By Beverly T. Galloway,
Chief of the Bureau of Plant Industry.

INTRODUCTION.

In order that the work of the Bureau of Plant Industry may be most economically and efficiently conducted it is maintained on a "project" basis. The project, or problem, is planned always with the idea of benefiting agriculture either directly by increasing, improving, or saving a crop or indirectly by securing, assimilating, and giving advice which the farmer can turn to practical account. It is proposed in this paper to give a brief statement of progress made in some of the newer projects having for their object the betterment of agriculture. Part of the work is nearing completion, part must still be looked upon as being merely in the formative stage, and part is only just shaping itself so that its full importance and bearing are beginning to appear. The work being necessarily slow and filling in, as it were, gaps in other lines of investigation, it seems desirable to report progress from time to time.

In nearly all the projects discussed the principal work has been done by Mr. George W. Oliver, who has carried out the suggestions of the writer in such a way as to make possible the results stated.

DEVELOPING NEW LETTUCES FOR GROWING UNDER GLASS.

The growing of lettuce under glass is an important industry, especially in the eastern United States. The large winter plantings of lettuce in Florida and other southern sections have to some extent curtailed the output of the glass-grown crop; still, the quantity of lettuce grown in greenhouses for special markets is great. While a considerable number of types of lettuce specially adapted for culture under glass have been developed in the last fifteen or twenty years, none of them is entirely satisfactory. This may be said, of course, of almost any crop. In other words, there is opportunity for improvement in almost every crop that the farmer or gardener may grow. The eastern markets demand a head lettuce, while those of the West require a lettuce of loose type, that is, a lettuce without a head, but a good vigorous grower. The shape, color, and size of the plants have

much to do with their marketable qualities and their successful production. The eastern markets demand a medium-sized plant, that is, ranging from 10 to 12 inches across, with a good, firm, light-colored head. The outer leaves of the lettuce should also be light in color, tender, and preferably curled or puffed. This gives a type of lettuce in which the head can be used for salad and the outer leaves for dressing. Still more important, it is essential that the plant shall be hardy, quick to mature, not liable to run to seed early, and able to resist certain troubles that affect the plant under glass, such as top-burn, a physiological disturbance, and stem-rot, a fungous disease.

For the more western sections of the country, as already indicated, the type of lettuce demanded is quite different from that in the East. A loose head, light in color and of considerable weight, is demanded by the markets. This type of lettuce is more easily grown than the head lettuce, not being so subject to disease, maturing more quickly, and being more uniform in growth. The Boston Market and Grand Rapids varieties represent the two types, the first being a head lettuce, the second a loose one.

Various efforts have been made by those interested in lettuce to improve existing types through selection. This was found to be a slow process, however, and very little progress was made. Four years ago the plan of hybridizing lettuces was conceived, and although the difficulties in the way were recognized an outline of the work was placed in Mr. Oliver's hands and numerous crosses were made. The ideal type of lettuce desired was formulated, and with a view of securing this it was planned to cross the Grand Rapids lettuce with a small-heading type known as the Golden Queen, believing that by so doing strains could be secured which would give what was wanted both for the East and for the West. The Golden Queen lettuce is small in size, with a firm head and bright golden color; it is hardy, but lacks adaptability to a wide range of conditions, and moreover lacks size and weight.

The resultant crosses gave, as usual, many variations. Rigid selection of these crosses, however, has resulted in the securing of two types of lettuce which are different from any of those now grown and which, so far as conditions here are concerned, fulfill the requirements as originally formulated. The first, which we shall call for the present No. 39–2, is a head lettuce (Pl. I, fig. 4), the result of a cross between Golden Queen and Grand Rapids. The original cross resulted in the production of several thousand seedlings, from which this parent was selected. Continuous selection under glass has resulted in practically fixing the type as desired. The plant is a rapid grower with a large-sized head, the outer leaves are a bright golden yellow, while the inner leaves and head are a bright yellow, shading off to whitish toward the center of the head. The head is firm and

exceedingly tender and sweet. The plants under test here have been more resistant to top-burn and the damping-off disease than the parents. The accompanying illustrations (Pl. I, figs. 1, 2, and 4) show more fully the difference between the improved lettuce and the parents from which it sprang. All the plants illustrated are of the same age.

Altogether, this new lettuce seems to be a promising type, and it is hoped within the next year or two to be able to distribute quantities of seed to those who are interested in the production of this crop. This variety is adapted especially for cultivation under glass through the eastern United States. It has not been tested thoroughly out of doors, and no claims can therefore be made for its growth under these conditions.

The second type of lettuce which has been secured and which is especially adapted to regions where the Grand Rapids variety is now grown is known as No. 44B. This plant (Pl. I, fig. 3) was raised in 1904 from seed secured by crossing the Golden Queen with the Grand Rapids during the summer of 1903. The variety is almost intermediate between the parents. At first glance it seems to favor the Grand Rapids more than the Golden Queen. The leaves, however, are more crinkled and less fringed than in the Grand Rapids. When fully grown the heart leaves come close together, as if making an effort to form a head. It may be said to be more compact than the Grand Rapids, of a decided yellowish-green color, forms more rapidly, and is not quite so tall, but weighs more and comes to maturity quicker than its pollen-bearing parent. The flavor is said by some to be an improvement over that of the Grand Rapids. So far no disease has been seen, but it has not been grown in large quantities nor under varied conditions up to the present time. It sets seeds very finely even during the winter from autumn-raised plants. The original plant was one occurring in a house containing 2,500 second-generation hybrid plants in which more than 30 distinct forms occurred. No. 44B is the only one among the selections made at that time which came true in subsequent generations. The seed we now have is from fourth-generation plants. As a garnishing lettuce and as an edible form, No. 44B, we believe, is superior to Grand Rapids.

RUST-RESISTANT ASPARAGUS.

In recent years asparagus culture has been seriously threatened by a rust which comes on after the beds have been well established and by gradually weakening the plants results in great loss to the grower and in the ultimate destruction of the plants. The disease has been particularly severe in the New England States, where asparagus is grown as a profitable industry. It is also severe in other sections, especially on the Pacific coast, where some success has been

secured in the matter of its prevention, probably owing largely to favorable climatic conditions. All efforts to control the disease in the East through the usual methods of spraying and similar treatments have met with indifferent success. It seemed desirable, therefore, that attempts should be made to secure types of asparagus which would be able to resist the rust. To this end collections of asparagus have been made from various sections of the world, and in cooperation with the Massachusetts Agricultural Experiment Station work has been inaugurated in the matter of securing rust-resistant types.

The particular matter to which we wish to call attention now is the result of hybridizing conducted by Mr. Oliver with a species of South African asparagus secured by Mr. David Fairchild which seems to be rust resistant. This South African species (*Asparagus virgatus*) it is claimed has some other advantages over our types. The young growths are edible even when a foot high, and although the stalks are more slender than those of our cultivated types, this variety will probably prove a valuable addition to our stock of horticultural crops. Successful hybrids have been secured between the South African species and various varieties of our own asparagus. The ability of these plants to resist rust is yet to be determined, but the fact that we have secured the hybrids and that these hybrids, so far as appearances go, give every indication of possessing qualities of value, is worthy of note. Various crosses have also been made between different varieties of our own asparagus to determine the question of rust resistance.

NEW VARIETIES OF TOMATOES FOR FORCING UNDER GLASS.

The forcing of tomatoes under glass has assumed considerable proportions in the Middle and Northern States, and the demand for the greenhouse-grown crop is steadily increasing. This is due to the fact that tomatoes when grown under glass are superior to those that are grown in the extreme Southern States and which must necessarily be picked partially green and shipped long distances before reaching our markets. For special table use, such as is demanded by large hotels, the greenhouse-grown fruit will always be in demand. A number of varieties have been put on the market for cultivation under glass. Some of these are very good, but none has all the characteristics which would render it ideal. The ideal tomato is one with the following characters combined:

(1) A fruit without a depression at the stem end.

(2) A round fruit without ridges.

(3) A fruit with the interior well formed and compact.

(4) A fruit of medium size growing in large clusters.

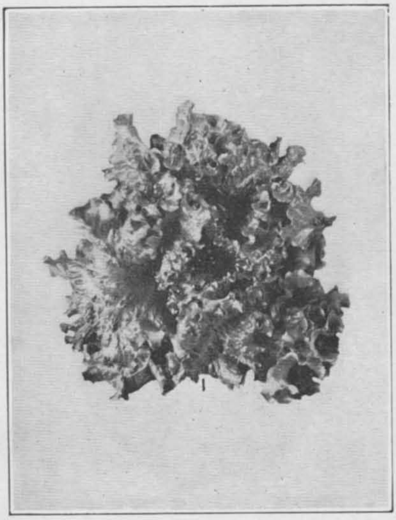


FIG. 1.—GRAND RAPIDS, ONE PARENT USED IN DEVELOPING IMPROVED TYPES.

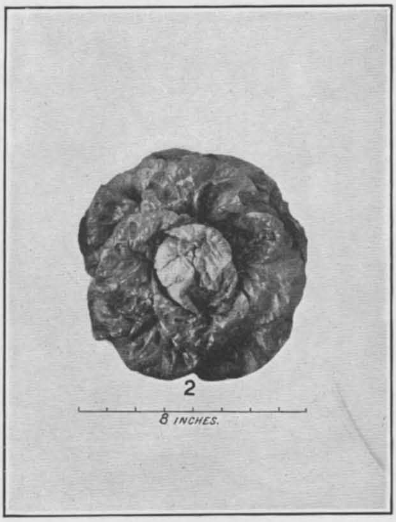


FIG. 2.—GOLDEN QUEEN, THE OTHER PARENT USED IN DEVELOPING IMPROVED TYPES.

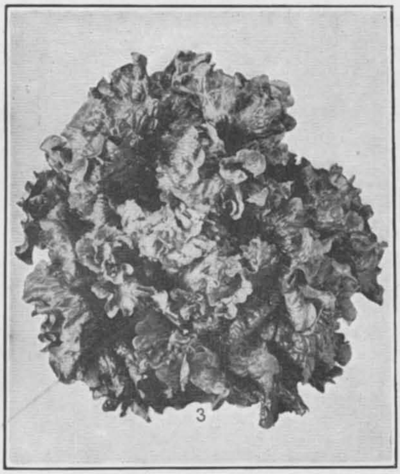


FIG. 3.—NEW LOOSE TYPE FOR THE WESTERN MARKET, SECURED BY CROSSING THE VARIETIES SHOWN IN FIGURES 1 AND 2.

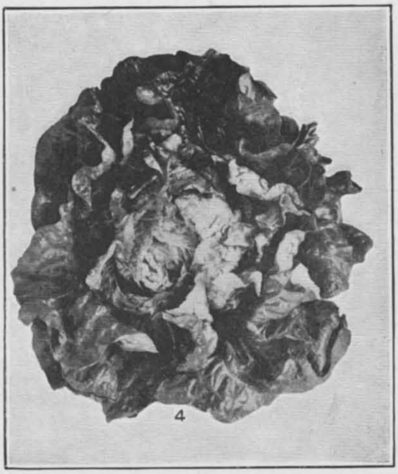
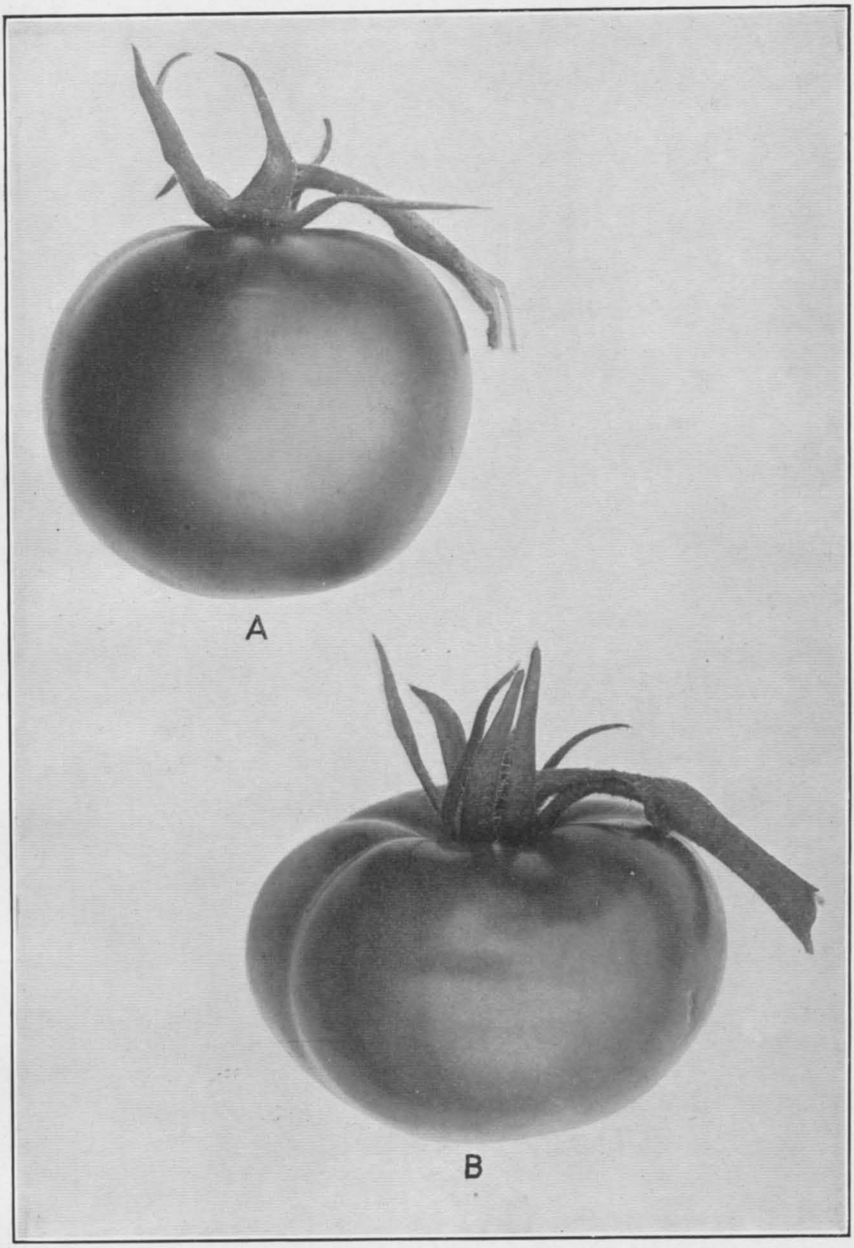


FIG. 4.—NEW HEAD TYPE FOR EASTERN CONDITIONS, SECURED BY CROSSING THE VARIETIES SHOWN IN FIGURES 1 AND 2.

IMPROVED TYPES OF LETTUCE AND THE VARIETIES FROM WHICH THEY WERE DEVELOPED.



IMPROVING THE TOMATO.

[A. Fruit of approximately ideal form secured by crossing and selection. B. Fruit showing imperfections and undesirable characters.]

(5) A plant having the first flowers as near the root as possible; that is, between the ninth and tenth nodes.

(6) A plant with the above characters showing the largest weight of fruit.

For the last three or four years the crossing of varieties has been carried on with a view to securing types with characters approximating those discussed above. Out of a large number of forms a few kinds were secured which gave promise of good results, and seedlings of these have been selected. Only about 20 of the last selection showed decidedly promising results. As the time taken to test a new tomato thoroughly is longer than with most vegetables, the work will continue in an experimental state for some time. The illustration (Pl. II) shows one of our new seedlings, a desirable form, compared with an undesirable type.

IMPROVEMENTS IN LILY CULTURE.

The growing of lilies in the United States is rapidly becoming an important industry. Large quantities of bulbs have in years past been imported from Bermuda, Japan, and other countries, and the demand for the flowering plants seems on the increase. Various lines of work have been undertaken and carried out by Mr. Oliver, chiefly for the purpose of securing new types of lilies by hybridizing and crossing and to demonstrate the practicability of growing lilies in the United States directly from seed.

One of the most promising hybrids has resulted from crossing the Philippine lily (*Lilium philippinense*) and the Bermuda lily. The Philippine lily takes two months to come into bloom from the period of planting the bulb, while the *Lilium longiflorum* and its various forms require in the neighborhood of five months. Therefore it would be a great saving if the time taken to force a good Easter lily could be reduced from one to two months. With a view to bringing this about the hybridization of the Philippine lily and the *harrisii* variety of the *Lilium longiflorum* has been effected. The result of the cross is a flower longer than that of *harrisii*, but not quite as broad and a little shorter than that of the Philippine lily. The segments of the flower of the *harrisii* are from 5 to 6 inches long. Up to this time we have had to depend on the Philippine Islands for the supply of the Philippine lilies, and they arrive early in the spring when we can not use them for forcing. By growing them in California we can get them in the fall in good time for forcing into flower during the winter. The plants so far grown in California do not show signs of the lily disease.

The second line of work in connection with the production of lilies has been under way for the past four years. It consists, first, of

selecting plants which show freedom from disease as manifested by spotted leaves and distorted flowers. The varieties selected are those well known under the names of *multiflorum*, *harrisii*, and *giganteum*. When these plants come into bloom the flowers are cross-fertilized, with certain purposes in view. The seeds from these plants are sent to California and other places about the end of the summer. They are planted out in the field in the following spring and in a year from that period the growth made by the seedlings is so great that hundreds of plants have been recently produced bearing in the neighborhood of 30 flowers to a stem. As one would naturally suppose, disease is not anything like as prevalent in these California-grown plants as it is in Bermuda and Japan, the present sources of supply of bulbs used in the United States. So far as the work has gone the results have been very encouraging, especially in southern California, so that we are reasonably certain that the supply of bulbs will in due course of time be produced within our own borders.

There is a large tract of country with soil suitable for lily growing in the southwestern portion of California, from Santa Barbara down and extending inward for several miles. The bulbs can be harvested by the 1st of August. Some of those produced during the past season from two and three year old plants are very large and satisfactory. Among some bulbs recently received by the Department of Agriculture was one which measured 14½ inches in circumference; others closely approximated this size. It would seem that the method of reproduction by seed, saving desirable types from the seedlings and propagating those only by division and not from scales, is the true solution of the problem confronting the Easter lily industry in the United States. Should it be found practicable to fix any of the varieties so that they will come absolutely true from seed, then the method of procedure will be facilitated.

A NEW SUMMER-BLOOMING DAHLIA.

In connection with the work on the improvement of florists' flowers a new summer-blooming dahlia has been developed by Mr. Oliver. This new race of hybrid dahlias has been produced within the past three years and it is believed will fill a long-felt want in supplying flowers of brilliant colors several weeks before the ordinary types of dahlias are available. The ordinary types of dahlias which are now grown are the only ones which have been hitherto improved by gardeners and florists. The seed-bearing parent of the new race is a species discovered three years ago in Mexico at an elevation of 7,000 feet by Mr. Federico Chisholm. The plants were forwarded to the Bureau of Plant Industry and have been crossed with the ordinary species, and as the result of these crosses more than 20 new forms have been developed.

NEW COSMOS DAHLIA, SHOWING SEED.

[Note the long, slender flower stalks.]

The principal feature of the new dahlias is the early period of blooming, which begins by the end of June or the first half of July. By the 1st of October the flowering capacity of the plants is practically exhausted, only a few scattering blooms appearing after that period. The accompanying illustration (Pl. III) shows the character and general shape of the flower and supporting stalk. One of the desirable characteristics of this new dahlia is its long stem, making it possible to cut blooms with stems 18 inches long without a waste of unopened flowers. The name "Cosmos dahlia" has been suggested by Mr. Oliver for the new hybrids because of the profusion of bloom. The foliage is very diversified, some plants having fern-like foliage, others single and coarse leaves. Only three colors have appeared so far in the flowers, namely, crimson, scarlet, and yellow in various shades. Three of the forms have shown signs of doubling, and the flowers of these were recrossed last summer in the hope of producing a reliable double variety. Both the single and double forms have set seed freely. When the seed is germinated in the month of January, good strong plants are ready for setting out by the middle of May.

IMPROVEMENT OF GRASSES AND OTHER FORAGE CROPS.

In connection with the general work on forage crops numerous questions have arisen with regard to the possibilities of improving these crops by hybridizing. Some of this work has been under way in our greenhouses at Washington for the past four or five years and results have been secured which it seems proper at this time to announce.

CROSSING TEXAS AND KENTUCKY BLUEGRASSES.

Little or no attempt has been made to improve our grasses by hybridization. The writer has had under consideration for a number of years the possibilities of this work, and three years ago suggested to Mr. Oliver the desirability of taking up the matter and making an effort first to bring about crosses between two grasses that might lead to the securing of a hybrid which would fit into conditions where neither of the parents was entirely suited. To this end work was commenced with Kentucky bluegrass and Texas bluegrass as the parents.

The value of Kentucky bluegrass is too well known to need any great comment. It is the standard pasture and lawn grass over the greater portion of the northern part of the United States, its western border extending through the eastern portions of the States of North Dakota, Nebraska, and Kansas, and its southern profitable range being the south Tennessee line, running northward into western North Carolina and central Virginia. The greater portion of the

seed of this grass is produced in the region near the central portion of northern Kentucky.

Texas bluegrass (see Pl. IV), on the other hand, occurs to a limited extent in the Gulf States, but it is not widely grown, owing largely to the poor seed habit which it possesses, which makes it very difficult to obtain seed or to sow it. Its agricultural value is mostly as a pasture grass, although it is used to some extent for lawns. On account of its limited use at present its range can not be definitely outlined, but it has demonstrated its ability to grow in the southern United States where Kentucky bluegrass does not succeed. It was thought that by combining the two grasses in a hybrid a variety might be obtained which would extend a desirable pasture grass farther south.

As a result of the crosses, which are the first, so far as we are aware, that have been successful in the case of grasses, no less than 10 distinct types have been secured, all of which are taller than Kentucky bluegrass. Of the crosses 8 have rhizomes; 2 have none. In some the leaves are broader than in the typical Texas bluegrass; in others, narrower. Up to the first half of 1907 these hybrids were grown in a cool greenhouse, mainly for the purpose of inducing growth to insure a large number of plants from vegetative propagation. Consequently not much opportunity has been given the plants to test their seed-producing qualities, but it is already apparent that the hairy processes which prevent the seed of the Texas bluegrass from being sown broadcast have been lessened 75 per cent in the crosses. The illustrations presented herewith (Pls. IV and V) show some of the striking characteristics of the hybrids. Most of the hybrids seem to have unusual capacity for the production of foliage—a very desirable thing for both pasture and forage purposes.

HYBRID CLOVERS.

Work has been under way for a number of years in the matter of securing new clovers and alfalfas by crossing. A very desirable and promising hybrid has been secured by crossing a clover from Prince Edward Island with the zigzag clover from Europe (*Trifolium medium*). The object of this work is to develop hardiness in some of our types of clover for the purpose of extending their range northward. The plant from Prince Edward Island is very dwarf, covering the ground with a dense mass of foliage, is very resistant to drought, and so far appears to withstand extremes of heat and cold. This is evidently due to the abundant supply of rootstocks which extend in the soil to a considerable depth, sending up growths from 1 to 2 feet distant from the crown of the seedling. The hybrid plants also produce very large rootstocks and are perfectly hardy at Washington, D. C.

FIGS. 1 AND 2.—PLANTS OF TEXAS BLUEGRASS CROSSED WITH KENTUCKY BLUEGRASS, SHOWING NEW VARIETIES DEVELOPED AND THEIR HABITS OF LEAF GROWTH.

FIGS. 3 AND 4.—PLANTS OF TEXAS BLUEGRASS CROSSED WITH KENTUCKY BLUEGRASS, SHOWING VARIATIONS IN HABITS OF LEAF GROWTH.

HYBRIDS BETWEEN KENTUCKY BLUEGRASS AND TEXAS BLUEGRASS.

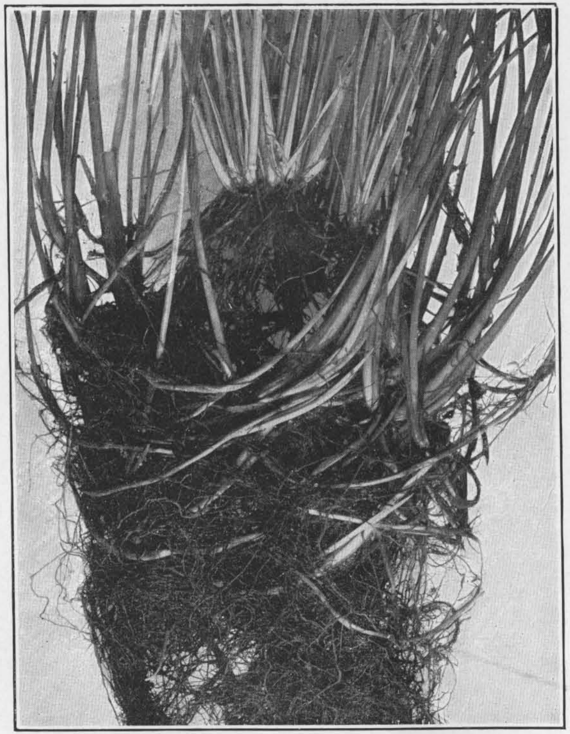


FIG. 1.—TEXAS BLUEGRASS, WITH LARGE ROOTSTOCKS AND TUFTED HABIT OF GROWTH.

FIG. 2.—HYBRID BLUEGRASS WITH SHORT ROOTSTOCK AND COMPACT GROWTH.

TEXAS BLUEGRASS AND HYBRID BETWEEN TEXAS BLUEGRASS AND KENTUCKY BLUEGRASS.

Numerous other crosses between species of clovers have been made, such as crosses between the red clover (*Trifolium pratense*) and *Trifolium hybridum*, and between the red clover and the white clover (*Trifolium repens*). Hybrids have been secured showing intermediate characters of the parents, but so far none of these hybrids has produced seed; consequently all died.

In the matter of alfalfa, numerous crosses have been made, the most promising being one which we designate as No. 15. This is a cross between Peruvian and Turkestan alfalfa. The resulting plant has a dark stem and medium-sized leaves and furnishes a large amount of forage and fodder. It also produces large quantities of seed and it is believed to have superior qualities as a hay plant. It has been grown out of doors for the past two winters near Washington without injury.

DEVELOPING NEW VARIETIES OF COWPEAS.

The cowpea is one of our most important crops, especially for the Southern States, and is coming to be looked upon as the clover of the South. Although there are numerous varieties of this important crop, nearly all of them fail in some important particular to give satisfactory results. Either the vines produced are too long and they are consequently difficult to harvest, or the leaves drop off early, or else they fail to set seed properly. Again, it is found that many of the varieties are subject to diseases of various kinds, both the parts above and the parts under ground being affected. It seems very desirable, therefore, to secure two or three new types of cowpeas which may be planted generally throughout the Southern States and which under varied conditions of soil and climate will mature a good crop of seed in such a way that it may be readily harvested by machinery, if necessary, and also will have characteristics of growth that will enable the farmer to readily harvest a crop of hay if hay is desired; types, furthermore, that shall be resistant to the various root diseases, will hold their leaves well, and will produce seeds which are able to maintain their vitality for a considerable time.

The ideal cowpea is one which is disease resistant, early fruiting, has an abundance of seed, and is strictly upright, or bush, in habit. To obtain the desired characteristics many of the most promising varieties have been flowered, crossed, and fruited in the greenhouse during the late winter and spring months. In this way it is possible to get two crops annually, thus reducing by one-half the time when the work will approach completion. The second and especially the third generation plants in the open field in several instances have shown very satisfactory progress toward ideal forms. Some of the crosses between the Indian variety and the Iron cowpea and between the former and the Unknown variety show some surprising

results. The last-named cross made vines much larger than either parent and larger than any of the numerous established varieties in the same field. The major portion of the plants was too late in coming into fruit. About 10 per cent of these seedlings came into bearing early, however. This habit of early bearing of the plants is accompanied by an upright habit of growth, with scarcely any long, trailing shoots. The fourth generation of these hybrids will be tested the coming season.

A peculiar feature in our cowpea hybrids is that many of them do not change the color of the seeds in the first, second, and third generations. Others, again, such as the Whippoorwill–Iron and Red Ripper–Iron crosses, split up during the third generation into as many as 12 very dissimilar sets of peas. The Whippoorwill and Iron crosses are in every way satisfactory in so far as earliness and abundance of pods are concerned. Only a very small proportion of the third generation plants come near our ideal of a bush plant, however. The progress of the work so far would indicate that successful results are bound to follow careful crossing and equally careful selection.

In conclusion it may be said that while this work is progressing satisfactorily, and while results of interest have been secured, the Department is not ready to distribute seeds or plants that have been developed. It is believed that some of these things may be safely sent out at an early day, however, and when they are ready special descriptive circulars will be prepared and the plan of distribution properly announced.

NOTABLE DEPREDATIONS BY FOREST INSECTS.

By A. D. Hopkins,
In Charge of Forest Insect Investigations, Bureau of Entomology.

INTRODUCTION.

In a review of the principal recorded depredations by forest insects in Europe and North America during the past four hundred years one is forcibly impressed with the idea that insects have exerted a most important influence on the history and modification of the forests, and thus indirectly on that of the countries themselves.

Among the natural destructive influences which have brought about changed conditions, storms, insects, and diseases have doubtless been primarily concerned in causing radical changes in local conditions, such as the successive disappearance of generations of matured trees, the disappearance of one or more tree species to be replaced by other species, or the total destruction of the forest cover.

The insects primarily concerned in depredations on living trees and in the killing of the timber over large areas fall, according to their food and breeding habits, into two groups. One includes those species of barkbeetles and bark-boring grubs which bore in the living bark and excavate burrows and galleries through the vital cambium, on the main stem or trunk, thus serving to girdle and kill the tree. The other includes those species which feed on the leaves and occur in such numbers as completely to defoliate the trees during two or more successive seasons, thus preventing the performance of the necessary vital functions of the foliage to such an extent as to cause the death of the trees.

DEPREDATIONS IN EUROPE.

It appears that the depredations by forest insects in the natural and planted forests of Europe during the past four hundred and fifty years which have been most notable in their character and extent have been caused by but a few species of defoliators and bark borers.

DEFOLIATING INSECTS.

"Nonne" moth.—The "nonne" moth (*Liparis monacha* L.) is light gray, stout-bodied, about 1 inch long, with wings spreading about 2 inches. It appears on the wing during July and August in vast swarms and deposits its eggs on the bark of the tree trunks. After the moths have completed their work of egg laying they die. The eggs remain on the trees over winter and until in April and May,

when they hatch into small, black, hairy caterpillars, which soon enter upon their mission of devastation. At first they congregate in small colonies, but later they become grayish in color and more active and scatter about, going from branch to branch and from tree to tree, feeding ravenously on the foliage and growing rapidly. This activity continues until they have attained their full growth as caterpillars. They then cease feeding and transform to the chrysalis stage in slight webs attached to the leaves, branches, or bark. About two weeks later the transformation to the moth, or adult stage, takes place and the life round, with its egg-laying and larval activity, is repeated.

The conifers, such as spruce, fir, and pine, suffer most from the ravages of this insect, but after it has completed the defoliation of the conifers, it will also attack the deciduous or broad-leaved trees and shrubs, such as beech and oak.

The history of the outbreaks of this insect is a story of repeated devastations and enormous losses of timber and expenditures of money in different sections of Germany, Austria-Hungary, Russia, Norway, and Sweden.

It appears that between the middle of the fifteenth and the beginning of the nineteenth centuries there were 17 invasions of the insect of sufficient magnitude to have been the subject of comment in European literature.

From 1794 to 1797 great invasions were reported from middle Germany to western Russia. Evidently these widespread and most alarming depredations were suddenly brought to an end by the appearance of a disease in June, 1797, which, like a great infectious pestilence, destroyed the caterpillars as rapidly as they themselves had destroyed the leaves of the trees. Bechstein, in his Forest-Insectology (1818), gives an account of the invasion in western Russia and its sudden termination, in which he says:

> It is horrible to travel in districts where these caterpillars swarm. Many thousand crawl up and down the trees. One can not take a step without treading on a number of them. There is a perpetual rain of their excreta, which often lies 6 inches deep, and being dissolved by the rain collects in puddles, which diffuse a pestilential stench. One can form no idea of the magnitude and terrible nature of the destruction. Fortunately, nature herself stopped the pest through a kind of dysentery which attacked the caterpillars in the beginning of June, 1797. This deadly sickness was attributed to a kind of mildew. The caterpillars collected together in great thick clumps 4 to 6 inches across, the excreta became pale, the intestines dirty, and so they died, leaving behind them a disgusting stench.

It is said that in 1839 and 1840 there occurred in the forests of northern Germany the first great outbreak of the nineteenth century. A writer in 1890 refers to this and subsequent invasions as follows:

> In connection with the injury caused by the "nonnen" in this century we may briefly mention here the extensive plague of 1839 and 1840 in upper

Suabia (Wurttemberg) which ravaged many hundreds of "morgens" of pine forest. The same thing was repeated in 1855, and at the present moment (1890) is appearing almost in the same spots in very serious manner. But the most considerable "nonnen" pest of all took place in Russia, and spread from 1845 to 1868 in a most devastating manner over Poland, Lithuania, and east Prussia. The invasion (of moths) in east Prussia began suddenly in 1853, in the night of July 29–30, and covered an area of about 60 German square miles in the administration of Gumbinnen, after it had already crossed over, in 1851 and 1852, the southern boundary of the administration of Königsberg. At that time the moths were driven by a storm into the sea while on their way, so that the insects were thrown by the waves upon the coasts for a distance of 10 German miles in a bank 7 feet wide and 6 inches thick, and were used as manure by the coast inhabitants. The extent of the ravages in Russia at that time was 6,400 German geographical square miles, and in east Prussia making a total of 7,000 miles. At the very least, 55,000,000 Prussian cords of wood, or 185,000,000 cubic yards of wood, became the prey of "nonnen" and bark beetles.

The next great invasion to attract general attention was in 1889–1892, which, it is said, extended over nearly all of Bavaria south of the Danube, causing a great loss and the expenditure of large sums of money in efforts to control the outbreak.

Large sums of money have been expended in various efforts toward the control of the "nonne." The methods which seem most effective are directed toward destroying the eggs on the trunks of the trees and preventing the migration of caterpillars from trees defoliated by them to adjacent uninfested trees or uninfested sections of the forest. This is accomplished by placing a band of some sticky substance, or so-called "birdlime," on the bark around the trunks of the trees. This acts as a barrier against the ascent of the caterpillars and also prevents some of them from coming down from the trees they have defoliated.

In 1892 the writer passed through a section of Bavaria in which all of the spruce trees for many miles were thus banded, and, in addition, thousands of small boxes were fastened in the trees to encourage the nesting of insectivorous birds.

In 1897–1902 there was an invasion of the "nonne" in Sweden. Information was secured by the writer through correspondence in 1903 with Mr. D. Cappelen, of Thelemarken, Norway, in regard to an outbreak of *Dendrolimus* (*Bombyx*) *pini* in Norway and the "nonne" in Sweden. The latter was first observed in the white pine. In 1898 it had spread over an area of more than 27,000 acres, and the sum of $100,000 was expended in fighting it. It is further stated that the white pine over about 7,500 acres was totally ruined, but the silver pine, which composed about 60 per cent of the same area, was not killed.

It appears that very satisfactory results were had from liming or gluing, at a cost of about $2 per acre. Experiments were also made

with a disease of the caterpillars, which seemed to result in spreading the infection.

Among the other defoliating insects which have habits similar to those of the "nonne" moth and which have caused notable depredations may be mentioned the pine spinner, the gipsy moth, and three species of sawflies.

PINE SPINNER (*Dendrolimus* [*Bombyx*] *pini* L.).—This is a stout-bodied, grayish-brown moth, considerably larger than the "nonne" moth. It appears on the wing in July and deposits its eggs on the trunks and branches of the trees during July and August. These hatch into caterpillars in August and feed on the foliage of the trees until cold weather, when they descend to the ground and hide in the moss and leaf cover, where they pass the winter. Early the next spring—February to April—they ascend the trees and feed on the foliage, as before, continuing to feed until June, when they make their cocoons, in which to transform to the chrysalis stage. These cocoons are attached to the twigs, branches, and trunks of the trees and underbrush, and the moths begin to emerge from them in July, to repeat the process of egg laying.

This insect, it appears, confines its attack to the pine. Its distribution extends from Lapland to Corsica and from England and France eastward to the Ural Mountains wherever there is a dense growth of pine.

It appears that one of the greatest outbreaks of this insect was in middle Germany in 1862 to 1872, over an area of 2,349 German square miles, in which the pine over some 100,000 acres was damaged and that on some 25,000 acres was eaten clean, causing an estimated damage of 2,366,000 marks ($565,000).

According to quite full information received by the writer through correspondence with Mr. Cappelen, of Norway, there was a destructive outbreak of this insect in Norway in 1900 to 1903, causing extensive losses of timber and the expenditure of large sums of money in efforts to control it. The remedies consisted in felling the small trees and "gluing" or liming the remaining ones, in the same manner as for the "nonne" moth, the work being done during the winter to prevent the caterpillars from ascending the trees the following spring. This operation was performed over some 7,000 acres in the winter of 1903, at a cost of about $2.65 an acre, more than 400,000 pounds of glue having been used. Evidently this treatment was quite successful in controlling the ravages of the insect, so far as the treated trees were concerned. It appears that considerable service was also rendered by the insect parasites and diseases of the caterpillars.

GIPSY MOTH (*Porthetria dispar* L.).—This is another insect somewhat similar in appearance and habits to the "nonne" moth, but larger. The presence of this insect in Massachusetts and adjoining States and its power of destruction render its history of especial interest, but since this has already been discussed in State and Government publications it is not necessary to refer to many examples of its work in Europe.

It is said that in the summers of 1854, 1855, and 1856 the zoological garden at Berlin suffered a complete defoliation, and that in 1874 and 1875 the willow hedges of the bürgermeister of Nöthlich were devastated. In 1875 and 1877 great numbers appeared on the Charlottenburg causeway and in the zoological gardens at Berlin.

In 1731 caterpillars of the gipsy moth committed terrible havoc among the cork oaks of France. In 1761 the trees in the orchards and gardens, the bushes in the fields, and the whole forests in Saxony and neighboring portions of Germany were defoliated. In 1794 there was another general outbreak of similar character. In portions of France the caterpillars were so abundant as to defoliate the forests in 1837. In 1871 the oak forests of portions of Italy were so entirely defoliated that many trees died.

FALSE CATERPILLARS.—There is a class of curious insects which resemble in general appearance and habits the caterpillars of moths, but which in reality are the larvæ of so-called sawflies belonging to the same order of insects as the common bees and wasps. Among the large number of species of this class of defoliators there are some which are exceedingly destructive. Those worthy of special mention in this connection include three species belonging to three different genera.

In 1857 one of these (*Lophyrus pini* L.) is said to have killed one-third of the older timber on 1,900 hectares of woodland in Wurttemberg and Bavaria, and between 1862 and 1896 three outbreaks of another species (*Lyda hypotrophica* Hartig) were recorded, one in 1862 in Wurttemberg, one in 1890 in Mährên, and one in 1888–1896 in Bavaria and Bohemia.

The species of special interest in this class is the larch worm, *Nematus erichsonii* Hartig of literature, which has from time to time during the last half century attracted attention in Europe and North America. The adult of this insect is about the size of the common house fly. It appears on the wing in June and July and deposits its eggs in the bark of new-growth twigs of the larch (known in this country as tamarack, hackmatack, larch, etc.). The eggs soon hatch into greenish worms or larvæ, later becoming grayish, which feed on the leaves during July and August, and often occur in such

numbers as to defoliate the trees over thousands of square miles. As soon as these larvæ attain their full development they descend to the ground, where they burrow beneath the moss and decaying leaves and enter the earth, each individual making a dense egg-like brown cocoon, in which it passes the winter as a larva. In June these over-wintered larvæ transform to pupæ, and a short time afterward to the adult sawflies, which emerge from the cocoons and fly to the tops of the trees to repeat the egg-laying process. This insect is now distributed throughout north and central Europe, the British Islands, eastward into Siberia, and in eastern North America [a] from central Michigan to Labrador.

The earliest records of depredations by this insect relate to an outbreak in Denmark in 1827–1829, followed by another in 1839–1847, and an outbreak in 1835–1838 in Holstein. In 1880 it was said to be abundant in Siberia, and in 1892 abundant and injurious in Sweden. In 1894 its first occurrence in Norway was reported. In 1903 it was reported as injurious to the larch in Finland, and in 1906 its depredations in Cumberland, England, were the subject of a special paper by Theobald and one by MacDougall. It is said that the most injurious and most prolonged attack of this insect took place in Denmark from 1839 to 1847. According to Boas:

> It appeared here in enormous numbers over some larch cultures covering some 360 acres. The larvæ were first noticed in 1839 on a small number of larches, but in 1840 the insect had already spread so much that half the larches were defoliated, and in 1841 matters were still worse, hardly a tree being spared, except the youngest. In 1842 and 1843 the damage was about the same as in 1841. Drought and cold probably kept the insect back in 1844. In 1845 the attack was about as in the previous year (1843?) and in 1846 it was worse than ever before. The trees, after several years' repeated defoliation, began to die, and it was noticed that the older trees were more sensitive than young ones. In 1847 the insect became still more destructive and attacked even the very smallest larches, which had hitherto escaped. In 1848, however, it completely disappeared almost in a twinkling, and there began to be hope that the forest would finally recover, in spite of the damage it had received, but, so far as can be learned from the meager information of later years, the larch forests had received an irremediable blow—the health of the trees had suffered too much.

BARK-BORING INSECTS.

Among the notable depredations by bark-boring insects on the forest trees of Europe those caused by the true barkbeetles hold first rank. Only a few species, however, appear to be primarily involved in the destruction, although there is a very large number of species which infest both the conifers and the broad-leaved trees after they have been injured or become unhealthy from some other cause.

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[a] See p. 158.

There are two or three species which are capable of killing spruce and pine, one or two destructive to the oak, and another is said to kill the elms.

There has been much dispute among European writers as to whether any of these barkbeetles really attack healthy trees and cause their death, or whether in all cases the trees must be weakened from other causes before they are invaded by barkbeetles.

This subject has received special attention by the writer for many years and, so far as several American barkbeetles are concerned, it has been clearly and definitely demonstrated that healthy trees are attacked and that sometimes widespread devastations are the result of these primary attacks. It would appear, however, that the European species are much less aggressive in this respect and that there most of the instances of barkbeetle depredation have followed as the result of previous injury by storms or by defoliating insects, and that the barkbeetles were only able to extend their depredations into the living timber after they had increased to enormous numbers in the injured trees. However, as will be seen by the following, these insects have been the final cause of enormous losses by preventing the recovery of injured trees and by extending their ravages into the healthy forests, thereby causing the expenditure of large sums of money in efforts to control them.

Eight-toothed pine barkbeetle.—Among the species of this class, one, the so-called eight-toothed pine barkbeetle (*Tomicus typographus* L.), is worthy of special mention, since it is the one most frequently mentioned in connection with the more notable examples of destruction of timber by barkbeetles. It is a small, reddish-brown, cylindrical beetle, the body sparsely clothed with long hairs, and the posterior ends of the elytra, or wing covers, deeply excavated, the margin of the excavation being armed with eight processes or teeth, the third on each side much longer than the others.

The insect passes the winter in the bark of the trees, where the broods have developed during the preceding summer. The adults appear on the wing, according to Eichhoff, "about the time the buds begin to open on the beech trees, or in April and May;" they then enter the living or dying bark of felled, injured, or standing living trees and excavate longitudinal branching galleries through the inner bark. Along the sides of these galleries eggs are deposited, which hatch into small grubs, or larvæ. These larvæ extend their food burrows through the inner layers of bark until they have completed their larval development, in May and June; they then transform to the pupal stage, and in June and July to the adult stage, thus completing the first generation. The adults of this generation proceed,

as before, to attack other trees and deposit eggs, from which the second generation develops and emerges in August and September, to deposit more eggs for a partial third generation, which passes the winter in the larval stage.

Of all the species of barkbeetles that infest the coniferous trees of Europe this appears to be the most important in its relation to the dying of timber and especially the widespread devastation following an invasion of the "nonne" moth of the felling of timber over large areas by storms. Such large amounts of weakened and dying timber at successive intervals present the most favorable conditions for the multiplication of this and other allied species, which, through a combined attack, either prevent the recovery of trees which might otherwise survive, or invade the living timber and thus extend the devastations started from some other cause.

Among the notable examples of depredations said to have been caused by this species alone or in combination with other species and causes, the following are worthy of mention:

It appears from German literature that between 1781 and 1783 there was a great invasion of *Tomicus typographus* in the Harz Mountains, Germany, as a consequence of which more than 2,650,000 trees had to be cut down, and later extensive mining industries in the devastated region were jeopardized by the scarcity of fuel. It is also stated that the severest attacks of this beetle began with the second half of the nineteenth century, following the invasions of the "nonne" moth of that period, and continued until at least 1862. A little later (1864–1870) came a period of terribly destructive storms throughout central Germany, Bohemia, and eastern France. The exact dates of some of these storms are given as November 6 and December 7, 1868, and October 26–27, 1870. These storms provided an enormous amount of felled timber to attract the barkbeetles, which at that time must have occurred in the greatest abundance. In various sections of the countries mentioned we consequently find references to most extensive depredations, which continued in the most alarming manner until about 1875.

Oberförster Eichhoff stated that in the Bavarian forests approximately 700,000 "km." of timber died and that this species, in company with four other barkbeetles, occurred in such vast swarms as to obscure the sun. He states further that in one reserve 1,000 workmen were brought in from Bohemia and Italy for the felling and barking of the trees and in two years (1873 and 1874) 70,000 florins (about $25,000) was thus expended.

It is stated by another author that the invasion of *Tomicus typographus* spread to alarming proportions and that the foresters of two countries put forth great efforts to guard against the invasion of the beetles by barking and promptly selling the wood of the fallen

trees; also, that after some 9,000 workmen had cut 2,700,000 cubic meters (95,348,000 cubic feet). of wood and in 1875 after having made a clean cut over more than 15,000 acres of surface and having cut down 300,000 trap trees, the invasion was brought to an end.

Another example of the same period is that contained in a translation by Hough from a special publication of the French forest administration issued in 1878. This relates to an extensive invasion by this and another barkbeetle in the spruce forests of the Jura Mountains following the storm of November 6, 1864. The depredations extended from the storm-felled to the standing timber and continued until 1872. It was not until 1869 and 1870, after more than 100,000 trees had perished, that proper measures based on entomological information were adopted, viz, felling and barking the infested trees before the broods of beetles had time to develop and emerge. By this means the insect was brought under complete control in 1872, after more than 181,000 trees had perished.

Twenty years later the writer visited a section in the Vosges Mountains, just north of the Jura, where a storm of March 30, 1892, had blown down some 500,000 spruce trees. To avoid a repetition of the barkbeetle invasion, every one of these trees had been promptly barked. This was a striking example of utilization of information gained from the experience mentioned above.

DANGER OF INTRODUCTION OF FOREST PESTS INTO AMERICA.

Already the gipsy moth, the brown-tail moth, the larch sawfly, and certain other insects injurious to the forest and shade trees of Europe have found their way into America, and, as usual, have proved far more destructive here than at home. Therefore it can be imagined what would happen if the "nonne" moth, the pine spinner, or the eight-toothed pine barkbeetle should become established in our pine and spruce forests, and especially in the National Forests of the Northwest, where the conditions would evidently be most favorable for their multiplication and destructive work. Therefore every evidence of the presence of a newly introduced pest should receive prompt attention.

DEPREDATIONS IN NORTH AMERICA.

Very little is known in regard to the early history of depredations of forest insects in North America, but from what we now know of the principal enemies of forest trees in different sections of the United States and Canada and of the prevailing conditions as regards the distribution of tree species and the average age of the matured or veteran trees, it is evident that insects were one of the important factors in forest destruction and forest modifications during prehistoric times as they have been within the past century.

The principal enemies of the living trees of American forests, like those of Europe, fall into the two groups of defoliators and bark borers, but the latter are more important than the former, and both in number of species and in destructiveness they greatly exceed the same class of insects in Europe.

DEFOLIATING INSECTS.

The defoliators which have caused the more notable and widespread depredations in North America, concerning which we have definite records, are the larch worm, the pine butterfly, the hemlock spanworm, the forest tent caterpillar, the gipsy moth, and the browntail moth, among which the larch worm occupies first rank as a destroyer of trees in North America, although it occupies a minor position in Europe.

LARCH WORM.—The larch worm of North America and that of Europe are evidently the same species, but whether or not this insect was introduced into America within historic times or, like a number of other species, has always been common to the northern zones of both continents, can not be definitely determined. The fact, however, that it is more abundant and destructive in this country than in Europe would indicate that, like many of our worst farm, garden, and fruit-tree pests, it was introduced through the agency of man.

A summary of the evidence relating to this insect in North America indicates that there have been about five more or less extensive outbreaks since about 1853, as follows: 1853, in Quebec; 1881–1886, a great invasion extending from Maine into New York and over the whole of eastern Canada, from Labrador to about 30 miles west of Ottawa, the invasion ending suddenly in 1886; 1889–1891 and 1894–1898, locally from Prince Edward Island to New York and Guelph, Ontario; 1903–1907; a great invasion extending from eastern Canada westward to a point just north of the middle of Lake Superior, and locally through New England, westward to Wisconsin.

The aggregate area covered by these outbreaks appears to be that of the natural distribution of the American larch east of Wisconsin, or about 600,000 square miles, in which a large percentage of the so-called matured larch has been killed.

As regards the outbreaks of this insect in Europe within the past century, the recorded years and periods were as follows: 1827–1829 and 1839–1847, in Denmark; 1835–1838, in Holstein; 1880, in Siberia; 1892, in Sweden; 1894, in Norway; 1903, in Finland; 1906, in England. It appears, however, that it has never been so common and destructive in any European country as it has in North America, but perhaps this is because it has been less successful in its struggle with natural enemies in Europe than in this country. It is very evident,

however, that it has some natural enemies in this country, or at least that there are some natural influences which bring about a sudden and almost universal check to its ravages in a given section of the country after it has been very abundant for three or four years, otherwise the larch would have been practically eliminated from the northern forests. As yet no method has been discovered by which this insect can be controlled, but the natural methods of control are being investigated, with a hope of their successful utilization and promotion in the future.

PINE BUTTERFLY.—The pine butterfly (*Neophasia menapia* Felder) resembles in general appearance the common cabbage butterfly, though differing somewhat from that species in color, markings, and structure. The earliest reference to the extensive depredations by this insect was in 1882, at which time it was stated that over a large area in the vicinity of Spokane, Wash., all the yellow pine had been nearly or totally stripped of foliage, giving the forest the appearance of having been scorched by fire.

According to information furnished by Prof C. V. Piper, at the time professor of entomology at Pullman, Wash., about the year 1883, the butterflies were so numerous that the bay at Seattle was almost white with their floating bodies, and in 1890 they were very abundant in the Olympic Mountains, where in 1895, according to his further account, thousands of the dead bodies of the insects covered the ground.

In 1896 Doctor Fletcher observed an outbreak in the elevated plateau which forms the interior of British Columbia, on western yellow pine, and at Vancouver Island, on Douglas fir. It is further stated that two years previously (1894), at the snow line on Mount Hood, the butterflies were observed in large numbers hovering about the tops of the trees, and the next year whole acres of the nut pine (*Pinus monticola*) began to die, and that the insect made its appearance during 1895 on the pine timber on mountains near Goldendale, Wash. During investigations of forest insects in the Boise Basin, Idaho, in 1905, an agent of the Bureau of Entomology was informed that in 1898 the dead butterflies occurred in such numbers as to dam the small streams. In 1899 the writer observed the 1898 work of the insect on western yellow pine in the Moscow or Cedar Mountains, Idaho. Here evidence was found that most of the trees would have recovered had they not been attacked by barkbeetles. Another agent of the Bureau was informed that in 1903 pine trees were defoliated on many square miles in southern Washington in the vicinity of Mount Adams, and in August, 1907, a correspondent reported the insect in large numbers on yellow pine in Spokane County, Wash., and another reported it from near Alpha, Idaho.

The insect has been recorded from California and Colorado northward into British Columbia. Evidently, while it appears at irregular intervals in such vast swarms as to attract general attention and vast areas of pine are often defoliated by the larvæ, its natural enemies prevent the continuance of its depredations in any one locality long enough to be independently destructive to the timber; yet it appears that the weakened condition, even from a slight defoliation, is sufficient in some cases to attract certain of the destructive bark-beetles, which are thus able to increase and start a new and more serious trouble like that following an invasion by the "nonne" moth in Europe.

THE GIPSY MOTH.—The gipsy moth (*Porthetria dispar*), brought by accident into the United States nearly forty years ago at a point near Boston, has spread throughout eastern Massachusetts into southern New Hampshire and southwestern Maine, and has also made its appearance at isolated points in Rhode Island and eastern Connecticut. Its damage to the large forests in this portion of the country has been very great, and its threatened spread into the timber forests northward has been for years the cause of much alarm. It appears in countless numbers, and the defoliation of the trees two years in succession frequently brings about their death. This is especially true of conifers. The loss it has occasioned by the actual destruction of forests, shade trees, fruit trees, and other vegetation is very great and must run into the millions of dollars. It has caused a great loss in the reduced value of real estate in the portions of the country infested. It has brought about an enormous pecuniary loss to holders of property from the expense of the war that has been waged against it. The State of Massachusetts alone has spent over $2,000,000 in efforts to control the pest. When the insect was first discovered it is safe to say an immediate expenditure of less than $100,000 would have stamped it out.

BARK-BORING INSECTS.

The most destructive enemies to coniferous trees are to be found among the barkbeetles. In this country there are several species which select prime healthy trees, avoiding in their attack those which are in an unhealthy or declining condition, thereby causing enormous losses, in many cases hardly to be estimated. In Europe the bark-beetles are almost without exception secondary in their infestation, preferring injured or weakened trees, and only attack those which are perfectly healthy when their numbers have enormously increased. Then by their repeated assaults even the most vigorous tree becomes so weakened as to fall an easy prey not only to the primary attackers but also to such secondary forms as may be present.

SPRUCE-DESTROYING BEETLE.—The spruce-destroying beetle (*Dendroctonus piceaperda* Hopk.) has proved itself one of the most

destructive species with which we have to deal. The earliest reference to dying spruce in the Northeast was in 1818, and another early record is 1831–32. About 1840 the mortality of spruce timber on the hills in the region of Newport, N. H., was very great, and ten years later (1850) the spruce was said to have turned red and died on about 500 acres in Irasburg, Vt. From that time to the present there are records of great destruction to the spruce forests throughout the Northeast. In 1897 Fiske found the spruce dying and infested with beetles in northern New Hampshire. In 1900 the subject was thoroughly investigated by the writer in the region north of the Rangely Lakes.

As a rule this species confines its attack to the older and more mature trees, killing them by excavating egg galleries which penetrate the cambium, or growing portion of the trunk, and cause a loss of the tree's vitality. The young larvæ, as they proceed from these primary galleries, form transverse burrows which destroy any cambium which may still be left, resulting in a rapid and complete destruction of the remaining life in the bark. The species extends from New Brunswick to New York, westward to the Lake Superior region, and northward into Canada. It attacks and kills the red, black, and white spruces, but only the larger trees. The amount of timber killed by it, as indicated by published accounts and the observations of the writer, has been very great; certainly within the last half century several billion feet of timber have been thus destroyed. Different authors and their correspondents have estimated for different areas the death of 10, 50, and as much as 90 per cent of the matured timber.

The results of the writer's investigations enable him to suggest a practical remedy, viz, the directing of the regular logging operations into the worst infested timber, so that infested trees can be cut and floated out. The adoption of this method has proved very satisfactory west of the Rangely Lakes, resulting in the saving of over $100,000.

Engelmann spruce beetle.—The Engelmann spruce beetle, as its name indicates, attacks the Engelmann spruce, often causing immense losses through its depredations. Like the preceding species, it attacks only the larger or matured trees, and evidently is the most important enemy of the Rocky Mountain spruces. From time to time it has caused widespread depredations, which were extended by great forest fires starting in the dead timber. Through an investigation made by the Bureau of Entomology in the Sierra Blanca Mountains of the Lincoln National Forest, New Mexico, it was found that 75 to 90 per cent of the spruce over an area of several thousand acres had been killed by this beetle. Another invasion which occurred some fifty years ago was particularly striking in the southern slopes

of Pikes Peak, Colo., at an altitude of about 10,000 feet, where nearly all of the timber had been killed by the ravages of this insect.

BLACK HILLS BEETLE.—The Black Hills beetle (*Dendroctonus ponderosæ* Hopk.), with habits similar to those of the preceding, causes the most serious of losses in forests. It occurs in the eastern sections of the Rocky Mountain region from the Black Hills of South Dakota to southern Arizona.

It was stated that in 1897–98 in the region of the Black Hills there were rectangular patches of dead timber on the tops of the divide or ridges and running up and down the slopes. The situation was investigated by the writer in 1901, when it was found that the depredations were caused by an undescribed species. An exhaustive report, based on these observations, was made in the fall of that year. Subsequent observations have proved it to be one of the most destructive enemies of forests, choosing, as it does, for its attack, sound, healthy trees in preference to those of lesser vigor and health. Wherever this insect is found in abnormal numbers its depredations on living timber are more or less extensive. It has killed between 700,000,000 and 1,000,000,000 feet of timber in the Black Hills National Forest, and is also demonstrating its destructive powers in Colorado and northern New Mexico. The methods recommended for the control of this beetle have been successfully applied in the vicinity of Colorado Springs and in a large Spanish grant in southern Colorado, where by felling and barking some 50 to 75 per cent of the infested trees the broods were destroyed and the insect so reduced in numbers that it could not continue its depredations. Thus, at a comparatively small expense, widespread invasion was evidently prevented.

MOUNTAIN PINE BEETLE.—The mountain pine beetle, also an undescribed species, resembles the preceding very closely, both in appearance and habits. It attacks injured, felled, and living silver pine, sugar pine, western yellow pine, and lodgepole pine. It extends north of Colorado and Utah westward to the Cascades and southward through the Sierra Nevadas. While this species sometimes apparently prefers to attack injured and felled trees, it is often found attacking and killing the living timber over vast areas. As an example of its depredations, through investigations made by the Bureau of Entomology, it has been found that in northeastern Oregon 90 or 95 per cent of mature lodgepole pine and yellow pine has been killed within the last three years over an area of more than 100,000 acres. It is very evident that this beetle has been an important factor in the destruction of matured forests in the Northwest in past years.

WESTERN PINE BEETLE.—The western pine beetle (*Dendroctonus brevicomis* Lec.) is especially destructive to the western yellow pine

in central Idaho and in the mountains and higher valleys of eastern Washington, Oregon, and California. As a rule, the largest and best trees are attacked; the winding primary galleries beneath the bark soon serve to girdle the tree and kill it, even before the broods of young have completed their development and emerged. The commercial value of the wood of trees killed by this barkbeetle is reduced by the bluing of the sapwood, even before the leaves begin to turn yellow. Thus the loss from the work of this beetle has been enormous.

Destructive pine beetle.—The destructive pine beetle (*Dendroctonus frontalis* Zimm.), through its ravages, causes large and severe losses. A destructive invasion which occurred in 1890–1892, as determined by the writer, extended from the western border of West Virginia through Maryland and Virginia, into the District of Columbia, northward into Pennsylvania, and southward into western North Carolina, an area of over 75,000 square miles, in which a very large percentage of young trees, as well as the matured trees, of pine and spruce was killed by it. In many places in West Virginia and Virginia nearly all the pine trees of all sizes were killed on thousands of acres, while shade and ornamental trees within the same area suffered the same as those in the forest. The total destruction of the pine and spruce of the entire area was threatened, but the severe freeze of December, 1892, and January, 1893, together with natural enemies, exterminated the pest or so reduced its numbers that no more timber has died on account of its ravages in that region since 1893. It has been more or less active in the States south of Virginia to Texas since 1902. In some localities and during some years it has killed a large amount of timber. The species may be considered as one of the most dangerous enemies and a constant menace to the pine forests of the Southern States. Records of extensive dying of timber in the Southern States are found dating back to the early part of the nineteenth century, and evidence now proves conclusively that these depredations were caused by this beetle.

Hickory bark-borer.—The hickory bark-borer (*Scolytus quadrispinosus* Say) has within recent years been the cause of enormous losses of hickory timber throughout the northern tier of States from Wisconsin to Vermont and southward through the eastern Atlantic States as far as central Georgia. While this beetle is very destructive and causes extensive losses, successful methods of combating it have been recommended. As an instance, the utilization of these methods in Belle Isle Park, at Detroit, Mich., proved very efficient and resulted in the saving of the valuable hickory trees on that island from any further depredations by this pest.

LOCUST BORER.—The locust borer (*Cyllene robiniæ* Forst.) is one of the most destructive wood borers. The larvæ penetrate the wood oftentimes to such a degree that it becomes literally honeycombed with their galleries. In fact, so extensive is the damage to natural growth, artificial plantations, and shade trees that in some sections within the natural range of the tree in the Eastern States, but particularly in the Middle West, where both the tree and the insect have been introduced, it is considered unprofitable to grow the tree for shade or timber. If the trees are not seriously attacked, the timber often attains sufficient size for use as posts before it suffers enough to be rendered worthless for such purposes.

CONCLUDING REMARKS.

A striking feature of nearly all of the great invasions by forest insects in Europe and this country has been their more or less periodical nature, and the more or less sudden check of the outbreak after a large percentage of the timber had been killed and within two or three years after the insect had become so abundant as to threaten the total destruction of the kind of trees attacked by them. This is to be explained by various natural causes, which, however, operate only after the greatest damage has been done, and often the invasion is far beyond human control. Therefore the object in future management of forests should be to utilize the authentic technical information relating to the species involved and the vital features in their seasonal history and habits, with a view to preventing destructive outbreaks or promptly adopting the proper measures for their control as soon as the first evidence of the insects' presence in destructive numbers is noted. In fact, the first evidence of an outbreak of a destructive insect should receive the same prompt attention as that required in preventing the spread of an incipient forest fire. Fortunately most of the barkbeetles can be kept under complete control with little or no expense by proper adjustments in forest management and lumbering operations.

The history of efforts toward the control of forest insect depredations in Europe as well as in this country shows that one of the greatest obstacles has been the failure to realize the importance of expert entomological information. This has resulted in the waste of time, energy, and large sums of money in absolutely worthless and often detrimental efforts before proper measures have been adopted and applied.

DOES IT PAY THE FARMER TO PROTECT BIRDS?

By H. W. Henshaw,
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As objects of human care and interest birds occupy a place filled by no other living things, and the various movements to protect and foster them would be fully justified were there no returns other than esthetic. Only the thoughtless and the ignorant still hold that the graceful forms and beautiful plumage of these masterpieces of nature serve their highest purpose when worn on a hat for a brief season, to be then cast aside and forgotten, the plumage dimmed and faded, the beautiful songs quenched forever.

While by no means insensible to the higher value of birds, the farmer who is asked to aid in measures for their protection is entitled to inquire as to the practical purpose they subserve and how far they may be expected to return his outlay of time, trouble, and expense.

Since most birds eat insects and since many eat practically nothing else, it is their insect-eating habits that chiefly invite inquiry, for so active and persistent are birds in the pursuit of insects that they constitute their most important enemies.

When birds are permitted to labor undisturbed they thoroughly police both earth and air. The thrushes, sparrows, larks, and wrens search the surface of the earth for insects and their larvæ or hunt among the leaves and peer under logs and refuse for them. The warblers, vireos, creepers, and nuthatches with their microscopic eyes scan every part of the tree or shrub—trunk, branches, and leaves—and few hidden creatures escape them. The woodpeckers, not content with carefully scrutinizing the bark and limbs of trees, dig into decayed and worm-eaten wood and drag forth the burrowing larvæ, which in their hidden retreats are safe from other enemies. The flycatchers, aided by the warblers, are ever on the alert to snap up insects when flying among trees and branches; while the swallows and nighthawks skim over the pastures and patrol the air high above the tree tops for such of the enemy as have escaped pursuit below. Thus each family plays its part in the never-ending warfare, and the number of insects annually consumed by the combined hosts is simply incalculable. It is well that this is so, for so vast is the number of insects and so great is the quantity of vegetation required for their subsistence that the existence of every green thing would be

threatened were it not for birds and other agents specially designed to keep them in check.

While birds are not numerous in the sense that insects are, they exist in fair numbers everywhere—or would were it not for the interference of man—and so rapid is the digestion of birds and so perfect their assimilative powers that, to satisfy the appetite of even a small bird, great numbers of insects are needed. Much of this food is hidden and must be searched for; much of it is active and must be vigorously pursued. Hence only by the expenditure of much time and labor do birds procure their daily food. With birds the struggle for existence is peculiarly a struggle for subsistence; shelter is obtained with comparative ease, and if climatic conditions are not to their liking they migrate to other regions.

When by reason of favorable conditions insects have multiplied and become unusually abundant, birds eat much more than at ordinary times; hence the importance of their services during insect invasions. It is not, however, at such periods that their services are most valuable. It is their persistent activity in destroying insects every day, at all seasons, and in every stage of growth—the long, steady pull rather than the spasmodic effort—that tends to prevent insect irruptions and to keep the balance true.

Few birds are wholly beneficial, and there are very few among the harmful ones that have no redeeming traits—that do not, occasionally at least, do good. Most birds most of the time are beneficial; a few birds most of the time are injurious. Certain species may be beneficial in one region and harmful in others, or perform useful services at one season and be injurious at another. Instead, therefore, of being simple, as at first sight they may appear, the relations of birds to man are complex. That the exact nature of the services they render may be better understood, the food habits of certain of the more prominent ones will be briefly reviewed.

INSECTIVOROUS BIRDS AND THEIR FOOD HABITS.

HAWKS AND OWLS.—The strong beaks and sharp talons of the hawks and owls at first sight might be thought designed for more serious work than the destruction of insects, and yet many of the birds of prey make insects an important part of their food. The little sparrow hawk lives largely upon grasshoppers and crickets, and some, even of the larger species, as the Swainson hawk of the Western States, in summer time live almost exclusively upon them. It is very fortunate that so many birds—the hawks among them—are fond of grasshoppers, since these insects multiply so fast and are so very destructive to vegetation that but for the check on their increase by birds the cost to the farmer of fighting them would be much greater than it is.

Important as is the work of some of the hawks in destroying noxious insects, this is by no means the chief service the group renders man. Within our boundaries are some 50 species of hawks and 35 species of owls. With the exception of perhaps half a dozen hawks, which subsist mainly upon birds, and the great horned owl, hawks and owls are to be classed as beneficial. It is not to be denied that occasionally the larger species carry off a chicken and kill some game, but such acts are exceptions to the general rule. Mice and other small rodents constitute the chief food of such of the species as are not largely insectivorous, and it is by the destruction of these pests of the farmer that hawks and owls earn protection.

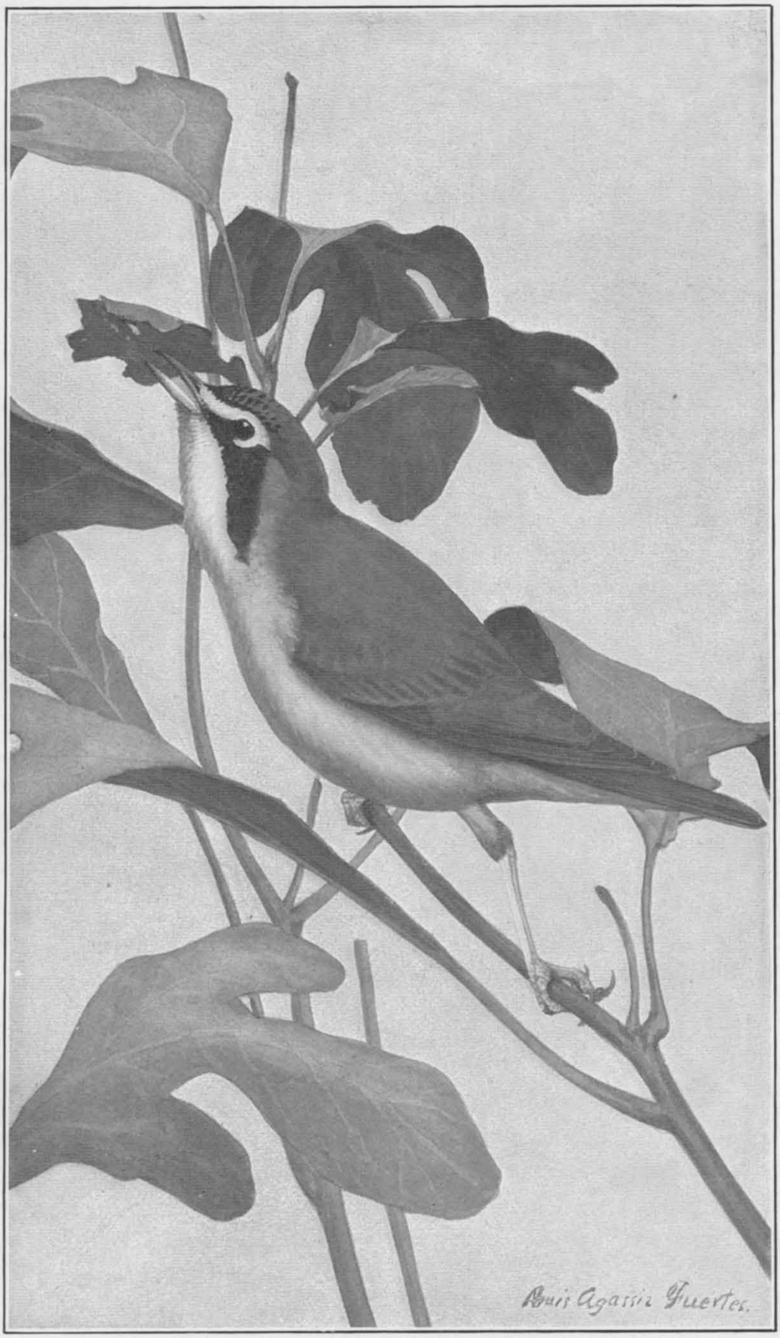
Of late years the acreage under cultivation in the United States has increased rapidly and the value of the crops raised has augmented by leaps and bounds. With increased acreage under cultivation the number of rodents has multiplied correspondingly, because of the abundance of nutritious food and also because their natural foes have been destroyed by man. The services of hawks and owls were never so much needed as now, and these faithful helpers of man are likely to be needed still more in the future; yet thousands of hawks and owls are yearly slaughtered because the part they play in nature's scheme is misunderstood or ignored. Unquestionably individual hawks that have learned the way to the poultry yard should be summarily dealt with, but because occasional individuals of two or three species destroy chickens it is manifestly unfair to take vengeance on the whole tribe. The very name "hen hawk" is a misnomer so far as the birds to which it is chiefly applied are concerned. Moreover, it is made the excuse by the farmer's boy and the sportsman for killing every hawk, large and small, that flies. Thousands of these useful birds are killed annually by the thoughtless for no better reason than that, when sitting motionless, they offer an easy target for the small-bore rifle, or, flying, present a tempting mark for the shotgun. So far has popular misapprehension in regard to these birds gone that again and again States and counties have offered bounties for their heads, thus depleting treasuries, and inviting heavy losses to the farmer through the increased numbers of insects and rodents, which it is the function of these birds to hold in check.

WOODPECKERS.—The woodpeckers apparently were expressly designed for the protection of trees, both forest trees and fruit trees. Their chisel-like beaks driven by strong muscles make effective tools with which to dig out of wood the larvæ of burrowing insects, in which work the long extensible tongues greatly aid. The nature and full extent of the services of woodpeckers in the cause of forest growth and preservation are more clearly recognized as the subject is more carefully studied.

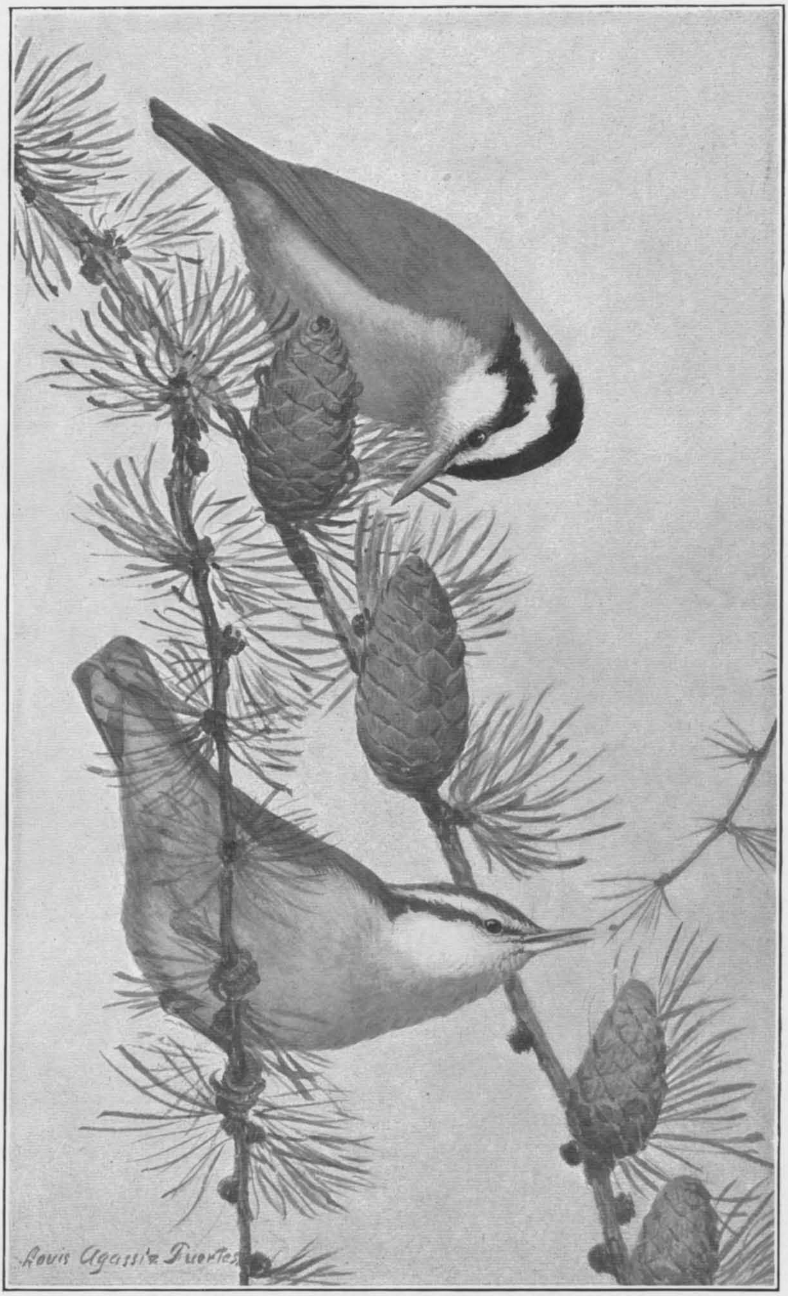
Of all our woodpeckers the sapsucker is the one exception to the rule. This species eats many insects, but its fondness for the sap of trees, including apple and other orchard trees, with its habit of cutting out sections of the bark to obtain its favorite tipple, renders it a nuisance in some localities. It is one of a number of birds that are harmful and beneficial by turns or according to locality. Little blame attaches to the orchardist who blacklists the sapsucker; but he should familiarize himself with the appearance of his enemy, that he may distinguish him from other kinds, so that his extreme measure of retaliation may not fall upon innocent species which can ill be spared.

Wood warblers.—America is peculiarly fortunate in possessing this beautiful group, in some respects unlike the birds of any other land, and excelled by none in grace of form, sprightly motions, and beauty of plumage. The family is large and numbers of the species included in it visit every part of our domain at some season or other. While some live on or near the ground and share with the thrushes the task of hunting for ground-frequenting insects, the great majority haunt the trees and shrubbery, and spend their time gleaning an insect harvest from foliage and twigs. Eggs, larvæ, and adult insects alike are welcome, and when flying insects are dislodged from their hiding places the warblers successfully essay the rôle of flycatchers and snap them up on the wing. No insects are too minute to escape their prying eyes, and they are particularly successful in discovering and devouring plant lice, immense numbers of which infest our fruit and shade trees. Finally, it may be said of the warblers that they are truly insectivorous, as they eat very little vegetable food, and the little they do eat has no special economic value. (See Pl. VI.)

Thrushes.—The thrushes and their near allies, the bluebirds, are two groups of insectivorous birds, all the members of which are fond of fruit. All sorts of wild berries are highly esteemed by them, and no one will deny that they are quite within their rights in appropriating them. Unfortunately, however, the most prominent member of the group—and in some respects the most highly esteemed—has developed an uncontrollable appetite for cherries, strawberries, and other cultivated fruits which often renders him a nuisance to the grower of small fruits. The fruit grower can hardly be expected to accept the confiding habits and the sweet song of the robin as full payment for a crop of cherries upon which depends a considerable part of his own livelihood and that of his family. In connection with the depredations of the robin, it is confidently believed that mulberry, wild cherry, and other fruit-bearing trees of little or no commercial value can be planted near orchards so as to protect the



A USEFUL INSECT-EATER—KENTUCKY WARBLER.



ONE OF OUR FOREST CONSERVATORS—RED-BELLIED NUTHATCH.

valuable cherry crop and so save the robin from the orchardist's just resentment. If so, all will be well with the robin; for in respect to his general food habits he is exemplary enough, and destroys many noxious insects, including cutworms and caterpillars. The food habits of the robin have been more carefully studied, perhaps, than those of any other of our birds, and special attention has been paid to the subject by the Biological Survey. That the robin's services as a whole far outweigh the injury he incontestably does to small fruits is the opinion of all investigators, and by the farmer at large he can ill be spared.

The catbird, to some extent, shares the ill name earned by the robin, and for the same reasons; but he is comparatively harmless, being neither so abundant near orchards nor so bold a marauder. Nevertheless, the strawberry patch too often knows him to the sorrow of its owner. He also consumes many insects—cutworms, caterpillars, and grasshoppers among the number.

The smaller members of the thrush family, the wood thrush, hermit thrush, and others, are highly insectivorous, and are to be credited with nothing but good. Moreover their melody raises them to the highest rank among American songsters.

Titmice.—The titmice, like the warblers, are tree frequenters, and the insects they pursue are of the same general character as those eaten by their more nervous and sprightly cousins. Instead of hurrying from tree to tree, and from one branch to another like the warblers, the titmice conduct a comparatively slow and painstaking search and go over their sylvan hunting grounds much more carefully. Another and a far more important fact to their credit is that, like the nuthatches (Pl. VII), they are practically non-migratory, and instead of scurrying off to the sunny Tropics on the first hint of cold weather, as do most of the warblers, they usually winter where they summer. Thus the farmer enjoys the benefit of their services the year round, and hence has twice the incentive to protect them that he has in the case of the migratory species.

Swallows.—The swallows are among the most insectivorous of birds, and it is difficult to overestimate the extent of their services to agriculture. They are flycatchers preeminently, and Nature has been at the utmost pains to qualify them for the delicate task she has set for them—the capture of small insects moving with rapid and uncertain flight through the air. Endowed with the power of swift and enduring flight, swallows cleave the air without apparent effort, turning this way and that, now falling, now rising, following the movements of their prey. The list of species is not lengthy, six only in the States east of the Mississippi and but one more west of that river, but not one of the number could be spared without loss to

the farmer. Valuable at all times and at all places favored by their presence, swallows have a peculiar value to the southern cotton planter, for they prey upon the cotton boll weevil as it flies over the fields on its errand of destruction. The more that swallows can be induced to nest in the cotton States, and the more they can be increased in the North, so as to add to the number that migrate through the South, the better will it be for the cotton planter, and incidentally for the whole country. Especially important is it that swallows be protected from the assaults of the English sparrow, which covets their nesting sites. Not only do these pests drive away swallows from their nests, but they even throw out their eggs and kill the helpless young.

VEGETARIAN BIRDS AND THEIR FOOD HABITS.

It is not possible strictly to divide small birds by their diet into vegetarian and insectivorous kinds, for while many birds live largely upon vegetable substances—some almost exclusively—there are very few that do not, at least occasionally, eat insects (all of them feed their young upon insects); and, it may be added, there are not many insect-eating birds that do not, at least occasionally, vary their diet by berries or other vegetable substances. Pigeons perhaps are more exclusively vegetarian than other birds, the common turtle dove, for instance, apparently never eating insects except when they happen to be contained in seeds or other vegetable food in the form of eggs or larvæ. For present purposes, however, those birds may be considered vegetarian which live chiefly and most of the year upon vegetable food.

It is among this group naturally that we look for enemies of the farmer, for cultivated grains and fruits are often so much more accessible than the wild varieties that it would be strange indeed if birds had not discovered their good qualities and promptly availed themselves of their opportunities.

Crows.—Crows are as widely as they are unfavorably known for their depredations on corn, especially when it is just sprouting, and their record is further blackened by their appetite for the eggs and nestlings of all small birds and of game birds. Bad as crows are, they yet have redeeming traits, for they devour great numbers of insects, especially grasshoppers and cutworms, and they kill also many meadow mice and other small rodents. The economic status of the crow is, of all birds, one of the most difficult to determine, but the balance is undoubtedly in the bird's favor. The offering of bounties to insure the destruction of crows is mistaken policy, for, as stated above, the crow performs important services to agriculture, and his extermination would be a loss to the country.

BLACKBIRDS.—Blackbirds also, of which there are several species, at times and in certain districts destroy grain. On the other hand, blackbirds consume insects in a wholesale way, and so incline the balance strongly in their favor.

ORIOLES.—Orioles eat insects to a much greater extent than vegetable food and are noted for their fondness for caterpillars. That the good done by orioles far outweighs the harm can not be doubted, especially since it has been ascertained that in the cotton fields orioles are persistent and successful enemies of the cotton boll weevil, and eagerly search the bolls for them, thus invading the very heart of the enemy's citadel.

BOBOLINK.—The bobolink, though in summer a deserved favorite at the North and there chiefly insectivorous, in autumn is responsible for damages to the southern rice patches that annually aggregate many thousands of dollars. The bobolink is thus almost in a class by itself, earning deserved protection in summer at the North by reason of its beautiful song and its insect-eating habits, while incurring the severest penalties at the South in the fall for serious depredations on the rice crop. No fair-minded critic can condemn the southern planter who protects his own by means of powder and shot. The extermination of the bobolink is not possible nor is it desirable, at least from the standpoint of those who cherish the bird in its northern home, but a material reduction of its numbers would probably effect a cure and satisfy the rice planters by making the bird practically harmless.

BLUE JAY.—The blue jay is another of our pronounced vegetarians whose fare, taking the whole year round, is largely composed of insects; and were judgment to be pronounced merely as between the good it does by destroying insects and the harm it inflicts by eating corn and fruit, the verdict would be in favor of the bird. A fact, however, recently brought to light seems to indicate that the blue jay is essaying a new rôle. As is well known, the brown-tail moth was introduced into this country a few years ago, and in the New England States has already inflicted serious injury. It will be fortunate for the country at large if the ravages of the insect can be limited to the States already infested. Contrary to the habits of our native moths the eggs of this foreign intruder hatch in the fall, and the young safely winter in their nests in the trees, to issue in the spring and begin their devastations on the opening foliage. Recently it has been learned that hundreds and thousands of these nests are torn open in winter and the young eaten, and the blue jay has actually been seen doing this. The blue jay will earn the title of benefactor indeed should he be able to contribute materially toward a reduction of this pest, which not only threatens destruction alike to village shade trees and country forest, but seriously afflicts humanity

by poisoning the flesh with its barbed hairs, which are scattered broadcast by the wind.

Grouse and quail.—Grouse and quail are largely vegetarian, though the several species have enviable records as successful hunters of insects. The habit of eating the buds of fruit trees in spring is sometimes cited against our ruffed grouse as a serious fault, but usually trees are not harmed by the process.

The value of all the members of the grouse family, as of waterfowl and waders, for food is great and is constantly increasing as the birds diminish in numbers. Quail have always been favorite objects of pursuit by sportsmen, and by preserving the quail on a large farm, or on a number of adjoining farms, and asking a fair fee from sportsmen for the privilege of shooting, a considerable revenue may be derived, and it is not unlikely that the game on a large tract of, say, several hundred acres may be made to yield a revenue as large as that from a good-sized poultry yard, or even larger. However, perhaps the most valuable service to the farmer rendered by bobwhite is the destruction of the seeds of weeds, although the total number of insects eaten in a year by a covey on the farm is enormous, and it is questionable if the value of game birds to the farmer, especially the quail, as weed and insect destroyers be not greater than their value as a source of revenue from sportsmen or as food. It is pretty safe to assert that, except where grouse and quail are so numerous that a certain percentge of the increase can be spared, the farmer can not afford to sacrifice them to sport or to the market. (See Pl. VIII.)

Sparrow family.—The finch, or sparrow, family is very important to the agriculturist. The group is large, and in North America comprises more than a seventh of all the birds. Most of them are small and plainly colored; some are gregarious, and most are migratory, leaving the United States in winter. Their chief value to the farmer lies in the fact that the majority of them are indefatigable in their search for seeds of weeds, which indeed constitute a large part of their fare the year round. (See Pl. IX.) Practically all of the food of at least one of them—the tree sparrow—consists of seed. If we estimate that a single tree sparrow eats a quarter of an ounce of weed seed daily—and stomach examinations by Professor Beal show that this is a fair estimate—this species in a State the size of Iowa consumes more than 800 tons of seed annually. And there are many other sparrows whose appetite for weed seed falls little short of that of the tree sparrow.

As every farmer knows, the cost of farming is largely augmented by the expense of fighting weeds, the seeds of many of which, especially of certain noxious kinds, are very numerous and are capable of germinating after being long buried in the soil. As weeds have been estimated annually to damage crop land on the average about a

A VALUABLE BIRD IN DANGER OF EXTINCTION—FIELD PLOVER.

A TYPICAL SEED-EATER—WHITE-THROATED SPARROW.

dollar per acre, and as the lands under crop in the United States in 1899 were 290,000,000 acres, the good work accomplished by the sparrows is of very great value to the farmer. Without their aid the cost of fighting weeds would be vastly increased, and no doubt in places profitable agriculture would be almost impossible.

Some of the sparrow tribe, as the purple finch and grosbeak, are fond of buds, and in spring may be frequently seen in apple, cherry, peach, and other trees, greedily eating the buds or the stamens of the blossoms. No doubt a certain percentage of fruit is lost through the agency of these birds, but budding by birds in itself, if not carried too far, is by no means objectionable; and neither of the birds mentioned, nor any native bird that shares the habit, is numerous enough (except in California) or sufficiently confirmed in the habit to seriously reduce the fruit crop. Indeed budding by hand to prevent overbearing and to improve the size and quality of fruit is a common practice, and it is probable that, as stated above, in most cases no actual loss of profit follows budding by our native birds. Whether so or not, the purple finch destroys many insects, caterpillars among them, and hence earns favor in the eyes of the farmer; while a still stronger case may be made out for the rose-breasted grosbeak, which is a most determined foe of the Colorado beetle, and probably destroys more of these dreaded insects than does any other bird—possibly than do all other birds combined. The insects eaten by the old birds, however, are but a tithe of the number they feed to their young, for nestlings thrive best and grow faster on a diet composed almost exclusively of insects.

Until the English sparrow was introduced it would have been safe to say that all the sparrows were friends of the farmer and deserved protection at his hands. Unlike our native species, however, this bird has bad habits far outweighing any possible good that it does, even if the most liberal estimate be made of the comparatively small number of insects that it destroys or the weed seed it eats. It is a conspicuous member of the seed-eating group, as its structure abundantly proves, and this well-known fact should have prevented its introduction into the United States to perform the service of an insect eater. By preference the bird is a scavenger of the city streets. Outside the city the bird's fondness for seeds does not stop with weed seed. The smaller grains are liable to attack at all stages of growth, from sowing time to harvest, and the total damage to the grain crop of the country inflicted by this pest at the present time amounts to many thousands of dollars annually.

This sparrow, like some of our native species, is fond of the buds of fruit trees. Where it exists in small numbers the injury it does in this way, like that of our own sparrows, is too small to count much against it; but the bird is very prolific and in many suburban

towns its colonies are so large that the resulting damage it inflicts upon fruit trees in spring is very great. It is fond also of all the small fruits, and in some regions the damage to fruit as the result of its attacks is considerable.

There is yet another field for the exercise of this pest's pernicious activity. Its aggressive and meddlesome disposition and its habit of acting in concert enables it to overpower and drive away many of our native birds, which before its advent were as numerous about dwellings as they were welcome.

The house wren, the bluebird, the phoebe, and certain swallows are the chief sufferers from the aggressive warfare waged by the sparrow. Even that excellent fighter, the purple martin, is unable to long resist the persistent attacks of a united colony of sparrows, since, when unable to overcome the martin in open warfare, the sparrows enter the nests during the absence of the owners, kill the helpless young, and pitch out the eggs. The result is that not only are the above-named species and other small birds driven away from the localities they used to inhabit, but their numbers have steadily diminished and must continue to do so because of their inability to find other suitable breeding places. Thus the sparrow has usurped the places about our homes by right belonging to our own birds, and its increase has been at the expense of native American species, with the result that a number of highly important useful species have been replaced over large areas by a single destructive one. Not only should all aid and comfort be withheld from this foreign invader, but a concerted effort should be made to reduce its numbers and to exterminate it wherever and whenever possible.

CRANES AND HERONS.—Some of our birds are neither insect eaters nor vegetable eaters. Some of the hawks and owls, as is well known, live chiefly upon flesh, while the cranes, herons, storks, and kingfishers live largely upon fish, crustaceans, and frogs. By eating small fish which are the fry of valuable kinds or serve as their food, these birds do more or less harm, as the fish breeder, whose ponds are invaded, knows well enough. So also their habit of eating frogs is injurious.

But while thus injurious to some extent in certain localities where their pernicious activity may necessitate reprisals, cranes and herons do good service in the destruction of small rodents, especially meadow mice and pocket gophers. As in other cases the relation of these birds to the community varies according to circumstances, and they are to be dealt with accordingly, bearing in mind, so far as possible, the good to the community as a whole and not solely individual interests.

IMPORTANCE OF BIRDS AS DESTROYERS OF INSECTS.

From the foregoing it will be seen that the benefits the farmer derives from birds far outweigh the occasional damage they do. Notwithstanding this, the public, as a rule, is much more alive to the depredations of birds than to the benefits that accrue from them. Nor is this surprising, since the disastrous effects of a raid on sprouting corn by crows, or upon ripening cherries by robins and cedar birds, are too apparent to be overlooked, and the resulting loss can be estimated in dollars and cents. Not so the benefits. Occasionally, it is true, the effects of a combined attack of birds upon caterpillars, cankerworms, or other insects which are present in unusual numbers or have played havoc with the foliage, are too evident wholly to escape attention; but more often birds work unnoticed, and the good they do is not at once obvious to the busy farmer. There are few visible tokens of the process by which the crop of hay or green feed has been saved from the cutworms by crows, or the potato crop rescued from the Colorado beetle by the grosbeaks. The birds have done their work quietly but none the less effectively. They have saved, or greatly assisted in saving, the farmer's crop, and nobody is the wiser, save the few who make it the business of their lives to study the habits of birds.

The time has long passed when the practical farmer can afford to ignore the relation of birds to agriculture. Larger and larger areas are being devoted to tillage every year, and the amount of capital invested in agricultural pursuits in the United States is constantly increasing. Irrigation, until recently almost unpracticed in the United States, is fast assuming national importance. The whole world is being laid under contribution for new fruits, forage plants, and crops for the benefit of the American farmer, in order that by his superior energy and foresight he may not only feed our own people but create a surplus of American products for consumption in less favored lands.

Along with these new introductions and as a necessary result of international commerce, new pests have been introduced. Here, under a favorable climate and new conditions, they multiply till they inflict great damage. The Hessian fly, San Jose scale, and codling moth are examples in point.

Such pests usually go unnoticed until the damage they do forces them on the attention of a community, when usually they are so numerous and widespread that their extermination is impossible. Once introduced into the country they are here to stay, and the vast sums already spent in efforts to stay the ravages of such pests emphasize the importance of utilizing to the utmost all the allies nature places at our disposal.

As a means of checking these introduced insect pests, as well as native ones, birds are of vast importance. Yet it must be remembered that, when once the reproductive powers of insects have had full play and an invasion occurs, the farmer can not suddenly augment the number of birds and summon the winged hosts to his aid. Birds reproduce but slowly, and in the natural course of events often suffer immense losses during their migrations, by climatic extremes and through the assaults of birds of prey and predaceous mammals. Hence a marked increase in the number of birds, either as a class or in the case of a given species, must come slowly and as a result of favoring conditions extending over a term of years. Moreover, as stated above, birds alone are inadequate to cope with sudden insect irruptions. It is their province rather by incessant watchfulness and constant warfare to prevent over-production of insect life rather than to reduce excess, although in the latter regard their aid is important. It is the part of prudence, therefore, to protect useful birds at all times, and so to augment their numbers that they may constantly play their respective parts in the police system ordained by nature and be ready, when emergency arises, to wage active and aggressive warfare against sudden invasions of insect enemies.

PROTECTION OF BIRDS FROM MAN.

Most of our States have laws which, if fully enforced, would go far to secure adequate protection for birds. The wholesale destruction of our songsters and insectivorous birds for millinery purposes has been largely stopped, although even now in some States the statutes are frequently violated by unprincipled bird hunters for the sake of gain. But laws, while wholesome and necessary, are not so effective for the protection of birds as is an enlightened public sentiment. In a country like our own, where education is general, a knowledge of the part birds play in the economy of nature is more effective for their protection than are any laws, however well administered. Instruction of this kind should be given to every school child in the land, and it is gratifying to note that the importance of this practical side of nature study is fast being recognized by educators. When the value of birds is universally known and they are everywhere cherished as friends, protective laws will be comparatively unimportant.

In this connection brief allusion may be made to a class of immigrants to our shores who are ignorant both of our laws and of the need for enforcing them, and who look upon birds, large and small, only as food. Cheap guns and ammunition in the hands of these newcomers furnish means for the indiscriminate slaughter of birds for the pot, and public sentiment is either not recognized or is ignored. Nothing but strict laws, rigidly and impartially enforced, can save our birds from these pot hunters.

MEANS OF ATTRACTING BIRDS TO THE FARM.

There are many ways of attracting birds to the farm and about the farmhouse. A convenient drinking and bathing place near the house is one of the most effective lures for birds known, as well as one of the cheapest. For wrens, swallows, bluebirds, chickadees, and other kinds, which build in cavities of trees, boxes may be put up, care being taken to protect them as far as possible from the aggressive English sparrow. Above all should the farmer pay attention to the cats on his farm. It is only recently that the extent of the depredations of the house cat on wild life, especially on birds, has been recognized. Many who have studied the matter believe that taking the year round cats are responsible for the death of more birds, especially young ones, than all wild animals put together. This may or may not prove to be an exaggeration, but unquestionably cats everywhere, especially on the farm, destroy vast numbers of birds. Even the well-fed and well-housed pet is responsible for many valuable lives, but the greater number are destroyed by strays which mistaken kindness has turned adrift, when not wanted in the house, to live as best they may. An adequate remedy against the bird-catching cat is neither easy to suggest nor to apply, but at least the farmer, who rightfully counts the birds of his farm as his friends, should be expected to destroy the stray cats that infest the country in summer, and, so far as possible, to see to it that the natural instincts of his own house pets are suppressed by ample feeding and reasonable restraint.

MEANS OF PROTECTING CROPS FROM BIRDS.

There are various devices by means of which the farmer may protect his crops from the attacks of birds, reserving the use of the gun as a last resort when all other methods have failed. Scarecrows, a dead crow hung on a pole, a white cord stretched around a field, the drilling of seed, and the tarring of seed corn are some of the old and approved methods of preventing losses by crows and blackbirds. To be effective, no one of these should be employed exclusively or too long at a time in the same locality, since long contact with man has taught the crow a number of things. Fruit trees when few in numbers may be protected by netting. The planting of wild fruit trees, or those possessed of little commercial value, for the protection of orchards has not received the attention in this country that it deserves.

Even when such protective devices fail the farmer is not driven to the wholesale destruction of birds. For it is being more and more recognized that there is much individuality among birds, and that generally the aggressors in a certain locality are a comparatively few

individuals. If the lives of a few destructive hawks, crows, or robins are taken, after other means have been tried and failed, it is often enough to protect the poultry yard or the crop.

FARMERS' GAIN FROM PROTECTING BIRDS.

The brief survey of the subject possible here only imperfectly sets forth the nature and importance of the service of birds to agriculture. Nevertheless it must appear that to the question "Does it pay the farmer to protect birds?" only one answer is possible. Even from the point of view of an investment for profit the time and expense necessary for their care and protection are richly repaid. There is the added consideration that without the music and companionship of birds the world would be the poorer. Anything that adds to the attractiveness of the farm and increases the interest of farm life is worthy of cultivation, even if no actual return is received in dollars and cents. Happily the farmer who protects birds secures a double return—increased profit from his crops and increased pleasure of living.

BACTERIA IN MILK.

By L. A. Rogers,
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MILK—ITS COMPOSITION AND CHARACTERISTICS.

A study of the changes produced in milk by bacteria is a study of the decomposition of the constituents of milk. Many of these changes are so complex that they can not be discussed in a paper of this nature. The fats are usually little affected by the growth of bacteria in milk. The sugar, on the other hand, is frequently fermented and various acids, gases, and alcohol may result. The casein and the albumen are decomposed by many bacteria. The products of the decomposition sometimes have sharp or disagreeable flavors and not infrequently unpleasant odors.

It has been shown that milk contains certain digestive principles—the so-called unorganized ferments, or more properly enzymes—which slowly digest the milk. Fresh milk, collected and held without bacterial contamination, will spoil in time unless these enzymes are destroyed by heating.

BACTERIA—THEIR NATURE.

To understand the changes that take place in milk it is necessary to consider briefly the nature of the minute organisms causing these changes.

The basis of all life is the mysterious jelly-like substance to which scientists have given the name of protoplasm. In its various forms it constitutes the actual living, changing part of every living thing, plant or animal. The simplest living things are merely shapeless, naked masses of this protoplasmic jelly. Bacteria show the first differentiation toward the complete plants with which we are familiar. The protoplasm is covered and held in definite shape by a very thin and delicate wall. They are then tiny one-celled plants. The plants growing in our gardens are made up of an infinite number of cells, organized like the workers in a community, each kind doing a particular work and all necessary to the complete plant. In bacteria, however, each cell is a complete plant in itself. (See figs. 1–4.) Their food must be in a condition to pass through the cell wall to the living protoplasm within. It must be in solution in water and it must be diffusible—that is, it must be a substance that will pass

through a membrane, otherwise it could not pass through the cell wall of the plant. Not all substances soluble in water will pass through a membrane. Thus albumen, while soluble, can not, as will be pointed out later, be used by bacteria until it has been changed.

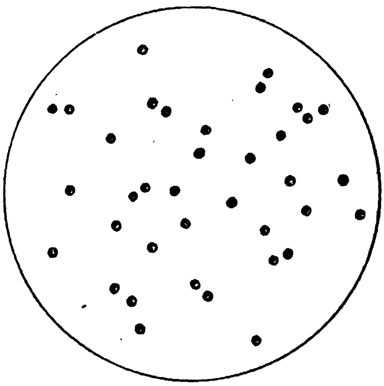

FIG. 1.—Bacteria of the spherical or coccus type.

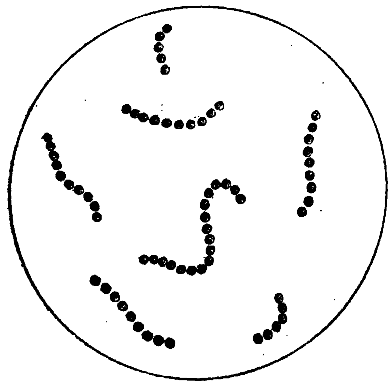

FIG. 2.—Bacteria of the coccus type hanging together in chains.

On the other hand, sugar is both soluble and diffusible and probably can be used for food by bacteria without previous change.

Through infinite generations of dependent existence bacteria have lost their ability to live independently and have become parasites or saprophytes. In other words, they are no longer able to elaborate

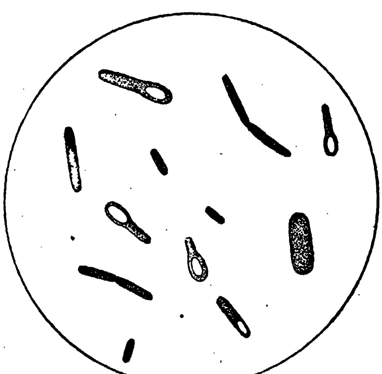

FIG. 3.—Typical rod-shaped bacteria (Bacillus type). In some of these spores are shown as clear areas.

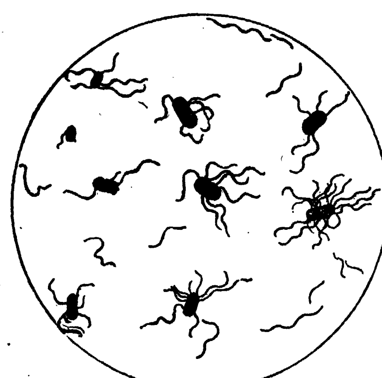

FIG. 4.—Bacteria with hair-like appendages which enable them to swim about in water or milk.

their nourishment from the simpler compounds existing in the air and the earth, but must depend on higher, better organized plants or animals to prepare their food for them. Hence we find them living only where there are present at least traces of animal or plant tissue. If they depend on living tissue they are called parasites; if they

obtain their nourishment from dead, partly decomposed plant or animal matter they are known as saprophytes.

The growing corn plant is so delicate that it is killed by a short exposure to a freezing temperature or to a scorching sun; yet the dried corn kernel will stand the most intense cold, long drying, or comparatively high heat, and when proper conditions are provided will grow. In a somewhat similar way some bacteria are provided with means of withstanding unfavorable conditions. These bacteria form a small round or oval body in the interior of the cell. When the bacterium dies this spore, as it is called, is set free. Like the seeds of the higher plants, it is able to survive long drying and great extremes of temperature. To destroy spores by heat it is necessary to expose them to long-continued boiling or for a short time to temperatures above the boiling point of water.

The bacteria are so small that it is difficult to form a conception of their dimensions. It is only when we consider them in the aggregate that they reach units of measure with which we are familiar. It is estimated that if 25,000 average-sized rod-shaped bacteria were placed end to end their combined length would equal one inch. The weight of an average bacillus is so small that it has been estimated it would take over 600,000,000,000 of them to equal one gram or 16,800,000,000,000 to weigh one ounce.

What the bacteria lack in size is made up in their great numbers and powers of reproduction. A cubic centimeter of milk which contains about 25 drops frequently contains thousands, sometimes millions, even hundreds of millions, of bacteria. A single drop of sour milk may contain 40,000,000 bacteria.

Bacteria reproduce themselves by a very simple process known as fission. The cell becomes elongated and a partition wall is formed across the middle. The two cells thus formed separate and we have two bacteria. Higher plants may take weeks and months or even many years to grow to maturity. These simple plants known as bacteria, however, may, under favorable conditions, complete their growth and reproduce themselves in less than an hour.

Bacteria, in common with all other living things, obey certain fixed laws. Certain elements and certain combinations of elements are necessary for their growth. There seem sometimes to be exceptions to these laws, but closer study shows that these exceptions are only apparent.

Their relation to temperature is most interesting and important. A certain amount of heat is essential and a certain amount is fatal. Each particular variety of bacteria has an upper and a lower temperature limit beyond which it does not grow and a certain temperature, called the optimum, at which it grows best.

Most forms occurring in milk find their optimum temperature between 80° and 98° F. Few bacteria grow at all above 100° and at 125° the weaker ones soon die. An exposure of ten minutes at 150° to 160° F. is fatal to nearly all bacteria which do not form spores. Spores, as previously mentioned, are destroyed only by prolonged boiling, exposure to steam under pressure, or to a high degree of dry heat. With dry heat, such as is obtained in an oven, much higher temperature and longer exposures are necessary to secure the same results. In the laboratory small flasks of milk are sterilized by holding them in a small steam boiler at a temperature of 248° F. for fifteen minutes. (See fig. 5.)

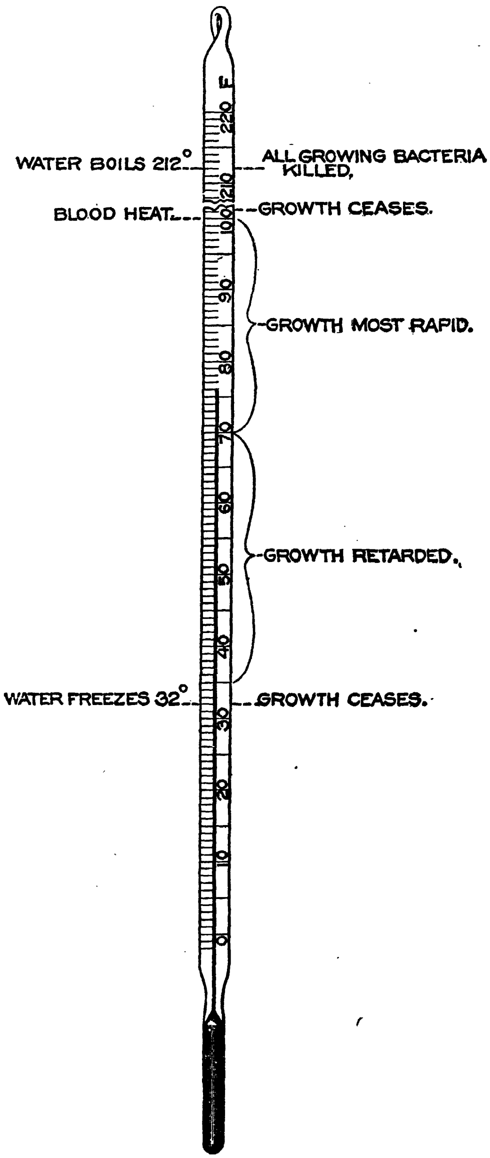

FIG. 5.—Influence of temperature on bacteria ordinarily fonud in milk.

It would be very easy for the layman to obtain the impression by reading popular descriptions that bacteria are peculiar and unusual plants having little in common with other forms of plant life. On the contrary, bacteria, in their form, habits of growth, and life processes, closely resemble many other simple plants, like the algæ, the yeasts, and the molds.

SOURCE OF BACTERIA IN MILK.

It has been assumed by many writers that milk is formed in the udder entirely free from bacteria. This has frequently been disputed and is still a matter of some doubt. However, the best authorities agree that milk is bacteria-free when formed, unless the

udder is so injured or diseased that there is a direct passageway from the blood vessels to the milk ducts. It should be remembered that an injury so slight that it would escape the most careful examination might be sufficient to allow the passage of bacteria.

Even if the milk is secreted bacteria-free, it is very difficult to obtain it perfectly sterile. Bacteria work their way into the milk cistern through the opening in the teat, and find there conditions under which they can grow and multiply. This growth is ordinarily confined to the lower part of the udder and the greater number of the bacteria are washed out with the first few streams of milk. Sometimes, however, the growth may extend into the smaller milk ducts and the last part of the milk will contain nearly as many bacteria as the first.

Inflammation of the udder or fermentation of the milk in the udder rarely occurs, because there is only a very small amount of milk held in the udder and most of the bacteria found there have little or no effect on milk. It is also true that fresh milk, like the blood, contains some substance which has an inhibiting influence on bacteria. This influence is so slight that it is probably of little practical importance, but it may have some relation to the comparatively slow development of bacteria in the udder.

The real contamination occurs after the milk has left the udder. In spite of careful milking, dirt, particles of dust, hairs, even bits of manure from the flanks or udder of the cow, may fall into the milk. All of these things invariably carry more or less bacterial contamination. Manure usually contains large numbers of bacteria, many of them being kinds which produce very undesirable changes in milk; and the dry dust of the stable floor contains great numbers and varieties of bacteria. This dust soon settles and an open milk pail catches a surprisingly large amount.

But the contamination does not end here. The pails or the cans may not be properly cleaned and the corners or seams may hold small particles of dirt or sour milk. These impurities are full of bacteria, which quickly find their way into the milk. The cloth through which the milk is strained may not have been properly scalded and the bacteria are not only not all destroyed, but have actually multiplied in the damp cloth. When the strainer is used again many of these bacteria are washed out by the milk.

If a cooler is used it may add to the contamination if it is placed so that it catches dust. Finally, the bottles in which the milk is distributed may not have been properly washed and steamed, and thus may become another source of contamination.

The contamination from each individual source may be small, but taken altogether it has a serious influence on the quality of the milk. If extraordinary precautions are taken to prevent contamination,

the number of bacteria in the fresh milk may be kept down to a few hundred per cubic centimeter; with careful milking it may easily be kept within a few thousand; with careless milking and handling the number will vary greatly with circumstances and may exceed 100,000.

If the milk is cooled and held at 50° F. or, better still, 40°, growth is checked at once and multiplication is very slow. One writer has represented the relative increase of bacteria in milk held at different temperatures as follows:

Multiplication of bacteria in milk held at different temperatures.

Milk held at—	Relative number of bacteria at the end of—				
	0 hour.	6 hours.	12 hours.	24 hours.	48 hours.
68° F.	1	1.7	24.2	6,128.0	357,499.0
50° F.	1	1.2	1.5	4.1	6.2

In the foregoing table, 1 is assumed to represent the number of bacteria in the fresh milk, and the relative numbers which will be found at the end of six, twelve, twenty-four, and forty-eight hours, at the two temperatures, are shown in the succeeding columns. These figures are based on a number of actual counts and illustrate the effect of a difference of 18° on the multiplication of bacteria. If the milk had contained at the beginning 1,000 bacteria, the part held at the lower temperature would have contained at the end of twenty-four hours only 4,100 bacteria, while the other would have contained at the same stage 6,128,000.

The temperature may have a decided influence on the kind of bacteria growing in milk as well as on the numbers. There is a constant struggle for existence among the various kinds of bacteria in the milk, and those which find the conditions most favorable or succeed in so changing the milk that it is more favorable or less unfavorable to them than to other kinds will gradually crowd the others out. If a sample of milk is divided into three parts and held at three different temperatures—as, for instance, 35°, 70°, and 98°—the bacteria predominating in each of these parts at the end of two or three days will probably be quite different. Thus we see how it is that milk may undergo so many changes. Even when milk is handled in the same way day after day there may be marked differences in its appearance or flavor. Changes in the conditions so slight that they may escape our notice may produce great variation in the final results. The amount and nature of the contamination must necessarily vary more or less from day to day. Even with the same contamination the temperature of the atmosphere may change the whole course of the fermentation.

The bacteria in milk from cows kept in stables may be different from the bacteria in milk from cows on pasture. Bacteria which occur rarely in milk during the winter months may become numerous in the summer, and specific fermentations which are almost unknown in the summer may appear in the autumn or winter.

It should not be assumed that all bacteria are harmful either to milk or to the human system. In fact, many kinds of bacteria will grow in milk for a long time without changing its taste or appearance, while many of the fermentations which make milk undesirable for direct consumption are used in making butter and various kinds of cheese. Very few of the bacteria cause disease or produce poisonous by-products.

FLAVORS IN MILK.

Milk may acquire abnormal flavors and odors in various ways:

(1) The cow may, through some pathological condition, produce milk with an unusual flavor. This may occur when the cow shows no outward sign of disorder and usually lasts for a short time only.

(2) Highly flavored foods may impart their peculiar flavors to the milk. The disagreeable results of feeding even small quantities of wild onion, turnips, and similar feeds are unfortunately too familiar to need comment. Other feeds with a less pungent taste no doubt affect the flavor of the milk to a less degree.

(3) Milk, especially warm milk, takes up the odors and flavors of the surrounding air with great rapidity. The flavor thus acquired may be so slight that it ordinarily passes unnoticed or it may be so pronounced that any one may recognize its source.

(4) The flavor of milk may be materially changed by the growth of bacteria, with the infinite variety of by-products which result from their development. If milk is sterilized and then inoculated with some one kind of bacteria, a certain flavor, frequently very pronounced, will result; and under the same conditions this particular variety will always produce the same flavor. Another kind may produce an equally pronounced but entirely different flavor, while some species may grow for a long time without causing any noticeable change. In ordinary milk, however, the conditions are different, in that many kinds of bacteria are growing together and the milk is usually consumed before there is any marked change in the flavor.

When a number of different kinds of bacteria grow together, as they usually do in milk, the development is not equal. One variety finds the conditions of food or temperature or acidity more suited to its peculiar habits of life and develops more rapidly than other kinds. In a short time this rapidly growing form may so change the milk that, while the conditions are more favorable to its own growth, they become less and less adapted to the needs of the others. In the course

of time this form crowds out all others and an examination would show large numbers of this kind, while the others originally present would have entirely disappeared or would occur only occasionally. It is in this way that the special fermentations develop.

If milk shows a peculiar flavor when it is first drawn, it is safe to say that the flavor is not produced by bacteria but by the cow, usually through something in the feed. If, on the other hand, the fresh milk is normal and the flavor develops as the milk stands, it is usually due to bacteria.

SOURING OF MILK.

Many of the lower plants find sugar a suitable food. In making use of this food, the sugar is chemically changed and in its place we find many new chemical compounds differing widely from the sugar from which they originated. Some bacteria in this process form various kinds of acids and gases. Among these is a large group of closely related bacteria which cause the souring of milk by breaking up the milk sugar into lactic acid. On account of this peculiarity they are commonly called the lactic-acid bacteria (fig. 6). Typical lactic-acid bacteria do not form gas. They do not have spores and therefore are destroyed at a comparatively low temperature. They are extremely widely distributed, and it is only under exceptional conditions that milk is obtained entirely free from them. They seldom or never occur in the udder itself, but probably are introduced into the milk with the hair, bits of feces, and dust that fall into the milk in the barn.

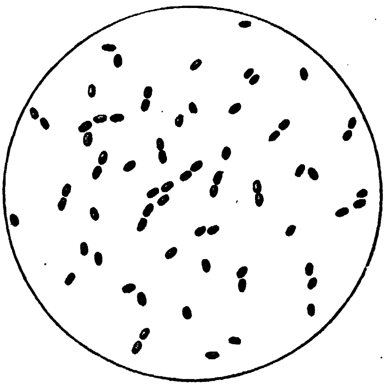

FIG. 6.—Typical lactic-acid bacteria.

Milk is an excellent medium for the growth of lactic-acid bacteria, and under favorable temperature conditions they multiply with astonishing rapidity.

The acidity of the milk is so closely connected with the life processes of this group of bacteria that it may be taken as a rough measure of their development. The acid, as fast as it is formed, unites chemically with the casein, which exists as very fine particles suspended in the milk serum. When the acid reaches a certain per cent the acid casein is precipitated and the milk is said to have "curdled" or "clabbered." This result may be hastened by heating. If milk or cream that is slightly sour is added to hot coffee, or is otherwise heated, it curdles.

Milk which has undergone a strictly lactic-acid fermentation has a firm curd, free from gas bubbles and with a small amount of whey on the surface. When shaken the curd breaks up into small particles which settle slowly, leaving a clear whey. The milk should have a pleasant acid taste. So far as is known, none of the products of the bacteria of this group is of a poisonous nature.

Some of the bacteria commonly classed with the lactic-acid bacteria form acids other than lactic, together with large quantities of gas. Milk curdled by bacteria of this class shows gas bubbles and has a disagreeable taste.

The lactic-acid bacteria not only are able to grow in an acid medium, but to a certain point the acid is a favorable influence. Many bacteria, however, find the acid detrimental to their development and are not able to grow long in milk in competition with lactic-acid bacteria. When the milk begins to taste sour the growth of nearly all nonacid-forming bacteria is checked. The activity of the lactic-acid bacteria themselves is checked and finally ceases entirely when the acid reaches a certain concentration, which varies with different varieties. Consequently sour milk usually contains a nearly pure culture of one or at most two or three closely related varieties of bacteria.

While the lactic-acid bacteria are considered very beneficial in butter and cheese making, they are undesirable bacteria from the standpoint of the milk dealer or consumer. It is almost out of the question absolutely to prevent their presence in milk, but the initial number may be much reduced by observing a few simple rules of cleanliness in handling the milk. Every precaution which reduces the amount of dirt in milk reduces the number of bacteria correspondingly. The important factors here are freedom from dust at time of milking, brushing the cows, wiping the udders, and small-mouthed milk pails. It is also of great importance to cool the milk as soon as possible after milking to below the temperature at which lactic-acid bacteria grow rapidly. This temperature is controlled by practical conditions, such as the temperature of the water available for cooling, but it should not be higher than 50° F.

SWEET CURDLING AND DIGESTION.

It sometimes happens that milk curdles without showing the usual acid taste. This is followed by the separation of a straw-colored whey, which slowly increases until the curd has nearly all disappeared. This condition is the result of a series of complicated changes brought about by bacteria.

When milk is taken into the stomach, especially the stomachs of young animals whose diet is largely or wholly milk, a certain constituent of the digestive juice precipitates the casein, forming a firm

curd. This curd resembles the acid curd in appearance, but differs from it chemically and has no sour taste. The part of the digestive juice which produces this change is the rennet, with which we are familiar in cheese making and in the junket tablets of the kitchen. It is what is technically known as an enzyme, and while it has some of the properties which we ordinarily attribute to living beings, its action is purely chemical.

In this precipitated condition the casein is not in a form to be used by the animal. It must be so changed that it will go into a solution and pass through the membranes lining the digestive tract. This change is brought about by another enzyme, pepsin. Pepsin changes the curd rapidly and completely into compounds soluble in water.

A process similar to these digestive processes in the stomach takes place in milk when it is subjected to the action of certain kinds of bacteria. The bacteria have no stomachs, but some of them have the ability to secrete enzymes somewhat like the rennet and the pepsin of animals. Thus the milk can or bottle becomes in a certain sense the communistic stomach of myriads of bacteria. From each cell is given out a trace of rennet and the digesting enzyme. These enzymes have the peculiar property of acting continuously without reduction of their power. Thus it happens that the milk is curdled in a few hours and the casein is slowly converted into products capable of passing through the delicate membrane surrounding the bacteria. The food thus produced is obviously far in excess of the needs of the bacteria.

A large group of bacteria, more or less closely related, produce changes of this nature. Some of them form by-products with disagreeable odors and tastes and some form gases. They are found normally in the soil, in water, in the filth of the stable, or the dust that floats in the air. They are invariably found in milk in greater or less numbers. They are ordinarily checked by the activities of the lactic-acid bacteria and become predominant only under special conditions. When, through careless handling, any exceptional number of bacteria of this class are introduced into the milk, they may bring about rennet curdling and digestion before they are suppressed by the acid produced by the lactic-acid bacteria.

Again, in hot weather the temperature of the milk may be so high that it is more favorable to the digesting bacteria than to the lactic-acid bacteria and the former gain the ascendency.

BITTER MILK.

The distinct bitter taste which sometimes appears in milk may be caused by (1) certain weeds that the cow has eaten; (2) an abnormal condition of the udder; (3) an advanced period of lactation; or (4) the action of certain bacteria. The first three causes of bitter milk need not be discussed in this paper. It is probable that the

bacteria causing bitterness are not at all uncommon and that they could be found in many lots of milk showing no bitterness. Some of these bacteria form acid and sour the milk; the more common forms, however, form little acid, and are checked by the growth of the lactic-acid bacteria. Nearly all of them form spores, and thus survive heating, which destroys the lactic-acid bacteria. For this reason bitterness has been most frequently observed in pasteurized and imperfectly sterilized milk. The few remaining spores germinate, and as they are unhindered by the presence of lactic-acid bacteria they soon reach unusual numbers and the bitter flavor appears.

The bacteria causing bitterness in unheated milk are more frequently those of the acid-forming classes, which are better able to compete with the lactic-acid bacteria. The acid formed by this group is usually butyric and not lactic. Some writers have stated that the bitterness is caused directly by the butyric acid. Nearly all of the bacteria known to produce bitterness bring about an active digestion of the casein and albumen, and it is probable that the bitter principle is formed in this decomposition. In most cases, however, the bitterness becomes evident before there is any visible sign of change in the milk.

Bitter milk may occur as an epidemic, persisting day after day and causing great trouble. This may be due to some constant localized source of infection which adds each day unusual numbers of bacteria to the milk. In some cases it has been found that the udder of a cow was infected. This should be determined by carefully cleaning the udders of all the cows and milking from each quarter of the udder of each cow into fruit jars or bottles which have been previously cleaned with boiling water.

In case one of these samples shows a well-developed bitterness while others remain normal, it may be assumed that the source of infection is the udder of the cow giving this milk. In that case there should be injected into the udder after each milking a solution of 1 part hyposulphite of soda in 100 parts of water.

It is probable in many cases that the source of infection is not localized. If through some combination of circumstances the lactic-acid bacteria are suppressed, other kinds become predominant. The utensils, the milk room, and the stable gradually become inoculated with these bacteria or their spores and each new lot of milk is thoroughly inoculated. The bitter milk bacteria may be one of the new forms. In this event it may be necessary, after thoroughly cleaning and steaming everything coming in contact with the milk, to introduce some good sour milk from a neighboring dairy. In this way the normal fermentation may be restored and the objectionable bacteria suppressed.

STRINGY OR ROPY MILK.

In this most troublesome fermentation the milk becomes what is commonly described as ropy or stringy. The milk is slimy and viscid. As this condition increases the milk may be drawn out into threads.

This fermentation should not be confused with garget, which appears in the fresh milk and is due to an inflammation of the udder. Ropy or stringy milk develops after the milk is drawn and is caused by the growth of certain kinds of bacteria. Although a number of kinds of bacteria causing this trouble have been studied as distinct varieties, it is probable that they are nearly all closely related. They do not form spores and are therefore destroyed by a comparatively low heat.

If a sample of ropy milk is examined under a microscope it is found to be filled with these small bacteria, each one surrounded by a capsule of a sticky, gummy substance. This gum or slime holds the bacteria together. When a thread is drawn out it is really a chain of bacteria held together by their sticky capsules.

Ropy milk is, so far as known, in no way detrimental to health. The famous Edam cheeses are nearly all made from milk which has undergone this fermentation. The peasants of Norway consider ropy milk a desirable beverage and bring about this fermentation by adding to fresh milk the leaves of certain plants on which the bacteria causing ropy milk are abundant. Most people, however, object seriously to milk with any tendency to form threads. This trouble frequently affects the milk of a dairy day after day and is removed only by the most drastic measures.

Outbreaks of this nature frequently occur in the cold months, because the bacteria of this group thrive better at low temperatures than the lactic-acid bacteria which hold them in check under normal conditions. In one case it was found that these bacteria were abundant in the dust of the stable. The trouble was removed by a thorough cleaning and whitewashing. In another serious and persistent outbreak it was found that the milk as it came from the dairy contained few or no ropy milk bacteria, but that they were abundant in the water tank in which the milk was held over night. The small amount of water occasionally splashed into the cans added sufficient bacteria to make the milk ropy in a comparatively short time. The utensils and floor had become so thoroughly impregnated with this organism that milk exposed in the room or strained through the wire strainer became ropy without contamination with the water. The trouble was removed by thoroughly scalding all the utensils, disinfecting the floor with a 5 per cent sulphuric acid solution, and destroying the organisms in the ice water by adding potassium bichromate. This was used in the proportion of 1 part in 1,000 or, roughly, 1 ounce to 1 cubic foot of water.

The source of the trouble can sometimes be easily located by taking small samples of the milk in clean glass jars at different stages in the handling. These should be covered, set away in a cool place to retard the souring, and examined after twenty-four to thirty-six hours for indications of ropiness.

In dairies getting milk from a number of farms the source of the difficulty may be located on some particular farm and proper methods taken to remove the source of contamination.

Any precaution is almost sure to be ineffectual if all utensils coming in contact with the milk are not thoroughly scalded, or, better still, steamed.

MISCELLANEOUS FERMENTATIONS.

In addition to the various fermentations previously described, milk may undergo many other changes as a result of the action of bacteria or other micro-organisms. The color may be changed. The appearance of color in milk is due to the growth of bacteria which produce a pigment soluble in water. All the colors of the rainbow, from bright red to violet, are formed by bacteria. Blue milk, which is the most common of the color fermentations, is probably due to contaminations from water, in which the blue and violet forming bacteria are known to occur frequently. It is only under unusual circumstances that these bacteria occur in milk in sufficient numbers to give any trouble.

Milk sometimes undergoes an alcoholic fermentation, and in some countries this is brought about by proper inoculation and control of temperature to produce a beverage. The alcoholic fermentation is usually caused by a yeast which has the ability to break up milk sugar into alcohol and large quantities of carbon dioxid gas. The ordinary yeast, such as is used in bread making, produces similar changes in cane sugar, but does not affect milk sugar. In the alcoholic drinks made from milk the alcoholic fermentation is usually combined with an acid fermentation. Koumis, a drink made originally in the Caucasus from mare's milk, is a combination of an alcoholic and a lactic-acid fermentation. This drink is believed to be beneficial in some diseases of the stomach and is frequently made from cow's milk. When made in this way with ordinary yeast it is necessary to add cane sugar.

DISEASE-PRODUCING BACTERIA IN MILK.

It is now generally recognized that many of the diseases which may be communicated from one person to another are caused by specific bacteria. The organisms causing some of these diseases have not yet been discovered, but the causal bacteria of many have been isolated and studied in detail. Some of these diseases occur usually only in

human beings, others occur usually in animals and are only occasionally transmitted to men, while others may occur with equal frequency in both man and animals.

It is well known that certain diseases are sometimes disseminated through milk. By this means an epidemic may appear suddenly and last for a comparatively short time; or the infection may be continued for a long period and the development of the disease be so slow and obscure that the source is unknown.

Tuberculosis is an example of the latter class. So much in regard to this disease is still unknown, so many widely separated views are held, even by those most familiar with the subject, that it is impossible to make positive statements. However, tuberculosis has been studied in such detail that many facts have been well established, and many theories advanced are so probable that they can not be disregarded until they are disproved.

The question of the identity of tuberculosis of man with that of animals has been raised, and, while it is not yet accepted as a fact by all investigators, a large majority of the people whose opinion has weight believe that the two diseases are identical. Assuming that they are, much difference of opinion exists as to the possibility of transmission from cows to man through milk. It is well known that other animals, including calves and pigs, may be infected by drinking milk from tuberculous cows, and the possibility that man, and especially children, may become infected in this way is so great that to disregard it on the ground that it is still unproved is carelessness approaching criminal negligence. The tendency among those who are studying the question most carefully is to consider milk as a serious source of danger.

A number of epidemics of diphtheria and scarlet fever have been traced to the milk supply. In diseases of this nature the milk is infected by someone suffering from an attack of the disease, or through someone who has been in contact with the patient. Obviously no one suffering from a contagious disease, or one who is caring for a diseased person, should be allowed to go near the stables or milk room or handle milk utensils. The only really safe way is to enforce strict quarantine against farms where contagious diseases are known to exist.

Typhoid fever, while not classed as a contagious disease, is communicated from one person to another. The ordinary channel of communication is generally considered to be the drinking water, which may be contaminated by sewage, but occasionally it is disseminated through the food. Milk may become infected with this disease in various ways. Contaminated well or spring water may find its way into the milk through milk pails, cans, or bottles which were not thoroughly scalded after rinsing in cold water; the cans or bottles of milk

may be left to cool in contaminated water and become inoculated by the accidental addition of even a few drops of water; the cows may wade in water or mud containing the typhoid bacillus and the small drops of muddy water which dry on the animal's flank may carry the organism to the milk; or flies may go directly from the waste from the sick room to the milk or milk utensils. It must be remembered that milk is an excellent medium for the growth of disease bacteria as well as the more harmless forms; and, if temperature conditions permit, the comparatively few bacteria carried in a few drops of water, a speck of mud, or the legs of a fly begin to multiply and soon reach dangerous numbers.

In this connection must be considered the summer intestinal diseases of children. While the specific bacteria causing these troubles have not been recognized in all cases, it is generally accepted that they are carried by the milk and that this is the important factor in their control. It has been proved by careful observation and statistics that the death rate among babies in the crowded cities can be materially lessened by supplying them with good milk. It is believed that these troubles are caused not by single species, but by a group of digesting bacteria, which produce poisons in the milk, together with other decomposition products. This class of bacteria is typical of old milk, milk that has been handled in an insanitary manner, or not kept at a low temperature.

THE HANDLING AND CARE OF MILK.

Preventing changes in milk is a question of preventing the introduction of bacteria into milk and of checking their growth or destroying them when they are present. The production of milk reasonably free from bacteria is a simple question of cleanliness.

How far a milk producer can go in this direction with profit is a question that each one must decide for himself. The model dairies which are used as examples of what dairymen should do are frequently maintained in such an expensive manner that the farmer or dairyman doing a small business or producing milk in connection with other lines of farming can not expect to live up to their standards without increasing the cost of his milk.

However, there are many simple rules and methods for handling milk, requiring little extra labor and no added expense, which will materially increase the healthfulness and keeping quality of the product. Any precaution that reduces the dust in the stable at milking time reduces the initial number of bacteria in the milk. The cows should not be fed before milking. Cobwebs and other dirt can be easily removed from the ceiling. The stable floor should be so arranged that the dirt on the flanks and udders of the cows will be

reduced to a minimum. The daily use of a brush will add greatly to the efficiency of these precautions. Care should be taken that the cows do not have to wade through filth in the barnyard.

Even with the greatest precaution some bacteria get into the milk, and further precautions must be taken to prevent their undue multiplication. The practical way to accomplish this is by control of the temperature of the milk. Advantage is taken of the natural law governing the limits and rapidity of growth of bacteria at different temperatures. The milk should be cooled at once to a temperature as near the freezing point as circumstances will permit. The usual limit is 50° F., but 40° F. is much more desirable.

The quickest and most economical method is to run the milk in a thin layer over the surface of a receptacle containing cold water. Many varieties of coolers for this purpose are on the market. Some are so arranged that a stream of water passes through them, while in others the milk flows over a conical tank containing cold water. A cooler should be located in a clean, well-ventilated room, or the benefits of cooling will be overcome by contamination from dust and the absorption of bad odors.

On farms where water is supplied by a windmill it is very easy to arrange the water trough so that the water flows from the pump through a trough or tank in which the cans of milk may be set to cool. This is a slow method, but much better than nothing.

It is not sufficient merely to cool the fresh milk. To insure good results it must be kept cold until used. The housekeeper who leaves her bottles of milk in the sun or standing in a warm kitchen should not blame the milkman for sour milk.

Various attempts have been made to preserve milk by holding it above instead of below the temperature favorable to the growth of bacteria. Devices for this purpose are called thermophores. While the most favorable temperature for many bacteria is at or near 98° F., few grow well at temperatures a few degrees above this point, and at 110° to 120° ordinary forms will not grow at all.

Milk held in thermophores usually will not curdle or change appreciably for several days, but it has been shown that unusual kinds of bacteria are able to develop at these high temperatures and that the milk, which has every appearance of being good, may contain large numbers of bacteria whose action is unknown. Devices for keeping infants' milk warm through the night should never be used.

Chemicals having an injurious effect on bacteria are sometimes used to retard the growth of bacteria in milk and thus prolong the time within which it may be sold. This practice is so universally condemned by public opinion that it need not be discussed here.

Heat is frequently applied to milk to destroy a part or all of the bacteria. Complete destruction of all bacteria in any substance is

sterilization; pasteurization is a term used to designate a process by which milk or other fluids are heated to destroy part, but not all, of the bacteria. Pasteurization may be "continuous" or "intermittent;" in the first method the milk flows in a continuous stream through the pasteurizer, where it is heated to the required temperature by steam or hot water; in the second method the milk is heated in a similar way, but is held at the pasteurizing temperature for some time.

The temperature for pasteurizing varies greatly. As a general rule, to insure good results the temperature must be increased as length of exposure is decreased. When the milk is held for twenty to thirty minutes the temperature may vary from 140° to 160° F. The former temperature is the lowest point at which the bacillus of tuberculosis is destroyed. To make the destruction of this bacillus certain the milk must be held at 140° for at least twenty-five minutes and be constantly stirred. In the continuous machines, where the milk is maintained at the pasteurizing temperature usually for only twenty-five or thirty seconds, the temperatures used range from 160° F. to 185° F. The results at 160° F. are uncertain, and any temperature below this point has little or no beneficial effect. Milk may be efficiently pasteurized in the household by setting the bottle of milk in a vessel containing water, and heating the water until the milk reaches a temperature of about 150°. It may then be removed from the stove and allowed to stand for twenty to twenty-five minutes. The temperature of the water will be above that of the milk, and while it slowly cools the milk will be thoroughly heated. It should then be chilled at once and kept cold until used.

Pasteurization should not be confused with sterilization. Even when the former is efficiently done, the vegetative or growing bacteria only are killed. Spores may resist boiling for several hours, and it is unusual to find milk entirely free from spores. Under proper temperature conditions these soon germinate and the milk may in a short time be worse than before pasteurization. In other words, pasteurized milk must be kept from contamination and warmth as well as the unpasteurized product.

Milk may be sterilized by repeated boilings. This is usually accomplished by steaming on three or four successive days. After each boiling it should be held at room temperature for twenty-four hours to allow the spores to germinate and reach the vegetative stage.

Sterilization may be effected in one operation by exposure to a temperature above the boiling point. To effect this exposure it is necessary to hold the milk in a closed chamber with steam under pressure.

Milk can also be sterilized by chemical means. The so-called "Buddeized" milk is sterilized by adding a small amount of hydrogen peroxid, which acts energetically on bacteria and is itself slowly

decomposed into two harmless substances, oxygen and water. Milk treated in this way is said to be not entirely free from an objectionable taste and the sterilization is not always certain.

While bacteria are in no way essential to milk, they may be considered as normally present in milk, cream, ice cream, butter, and cheese. They may even occur in milk or its products in very large numbers without making it an unsafe food or in any way decreasing its food value.

Bacteria known to produce disease are seldom isolated from or counted in milk, and bacteriological counts should be taken merely as an indication of the way in which milk has been collected or the temperature at which it has been held. High numbers usually indicate insanitary conditions, careless handling, or old milk. However, milk may be collected under very poor conditions and the bacterial count held down by a liberal use of ice. On the other hand, milk collected in the most sanitary manner may in a few hours contain a large number of bacteria if it is held at a high temperature. Low counts may be due not to clean stables and low temperatures, but to the use of antiseptics.

Every effort should be made by legitimate means to secure milk with a small number of bacteria, but milk or foods made from milk should not be indiscriminately condemned because they sometimes contain bacteria in numbers which are startling to those not familiar with the nature of these indispensable plants.

CHANGES TAKING PLACE IN CHICKENS IN COLD STORAGE.

By Mary E. Pennington,

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Extent and Importance of Cold Storage of Fowls.

While the preservation of food by cold has been in practical use for many hundred years, it has remained for the nineteenth and twentieth centuries to extend this industry to all parts of the civilized world and so successfully to commercialize the process of producing cold artificially that it is not only financially a success but is now indispensable to the food producer. Cold storage is entirely changing the character of the diet of certain tropical or semitropical peoples and, judging from the results of the introduction of ice into the Philippines, to their betterment. To our outlying possessions we are sending refrigerated articles, but the colonies of other nations are supplying the mother country with immense quantities of produce and are developing resources which, without artificial refrigeration, would lie dormant.

Especially interesting in this relation is the report on cold-storage poultry sent by New Zealand to England. In 1905 this colony shipped 15,176 birds—almost exclusively chickens and ducklings. They were frozen at 18° to 22° F. and transported in cold rooms, the temperature of which was generally somewhat below 15° F.

To insure the character of the birds exported in a frozen condition the New Zealand department of agriculture has arranged to receive them alive at the four principal ports of that island, kill, pluck, pack, freeze, and store them for a charge of 4d. each, a sum which is lower than the producer would have to pay working independently. The department also inspects each bird and reserves the right to reject any which are unsuitable, it having formulated a series of requirements regarding age, weight, etc., to which all the producers are required to conform.

This method removes one great difficulty and source of danger in the refrigeration of food products, namely, improper and unclean methods of killing and preparing for storage, and, what is even more important, it guarantees such prompt deposit of the birds in the refrigerating rooms that any decomposition previous to storage is prevented.

Although it is impossible to obtain exact statistics on the subject, it is estimated that approximately from 75 to 90 per cent of all the poultry produced in the United States is, for a longer or shorter period, preserved in cold storage. While the number of ducks, turkeys, and geese is by no means small, chickens, of course, are greatly in the majority, and from the appearance of the cold-storage warehouses in our large cities it would seem to be almost a matter of routine that every chicken intended for market should sojourn there for a certain, or rather an uncertain, time.

The storage of eggs for preservation by cold is almost exclusively confined to the early spring and summer, since at this time they are most plentiful. The placing of chickens in cold storage, on the contrary, may occur at almost any season, the large poultry raiser killing the birds of the age desired and shipping them to the warehouse, to be sold when the market is most lucrative. At certain seasons, however, practically clean sweeps will be made in the country adjoining large cities of all the birds suitable for market, so that for weeks afterward it is impossible to purchase fresh chickens. This is most apt to occur in the case of stewing and roasting chickens in early summer, when the broilers are well advanced and it is desirable to weed out all unprofitable laying hens and superfluous cocks. Hence, in the early summer the purchaser of any except broiling fowls is very likely to get those which have been in storage.

Opinions as to Time Cold Storage May be Continued.

Undoubtedly it is of great advantage to the producer, and of greater importance to the consumer, that poultry or meat of any type should be chilled as promptly as possible after killing, and long experience seems to indicate that the flavor of meats is improved if they are kept at from 2° to 5° C. (35.6° to 41° F.) for a few days. However, because of the modern demand for produce out of its natural season, as well as the efforts of the producer and dealer to derive the greatest profit possible by selling when the market is shortest, we have developed a system of refrigeration under which foodstuffs are kept for months and years and then offered for sale without any label to distinguish them from fresh materials.

It is the contention of many that there is practically no alteration in meats or poultry when kept in a solidly frozen condition, no matter how long the period may be. Others assert that beyond a certain limit of time, variously estimated at from three months to a year, cold-storage foods are unfit for human consumption. Accordingly attempts have been made in several States to secure legislation which shall control the sale of cold-storage products. The evidence set forth by those in favor of unrestricted cold storage, chiefly men connected with the cold-storage industry, is to the effect that undrawn

poultry may be preserved by cold for an almost indefinite length of time without any appreciable changes in the edible portions.

The manager of a Cleveland, Ohio, storage company states: "We have carried undrawn poultry successfully and with very little detriment to the stock for a period of two years." The assistant secretary of a refrigeration company of New York City says:

> In our experience we have carried frozen undrawn poultry for four years and found it as to appearance at the end of that time in a wholesome condition, and the same was eaten with no injurious effects. Poultry kept in a freezer and kept at the right temperature will keep for an indefinite length of time in a healthful condition.

The manager of a cold-storage and warehouse company of Boston, Mass., who has been in this business for many years, says:

> The length of time that undrawn poultry can be held in a healthful condition at a low temperature is very indefinite, but such time is surely not less than one year.

While opinions such as here quoted indicate that the trade, at least, is fairly unanimous in believing that poultry may be kept for long periods without change, there is considerable latitude as to the actual length of time that cold storage is advisable. While one dealer conservatively fixes one year as certainly safe, another believes that there is no limit to the period that poultry may be kept, provided the temperature be "right."

Cold-Storage Temperatures.

Here again a mooted question arises, and in the absence of investigations conducted with scientific accuracy we must rely upon the observations of the practical cold-storage warehouse men. It is generally conceded that the freezing of the fowl should be as prompt as possible, therefore some warehouses place the chickens for a few hours at —10° F. (—23.33° C.), transferring them, when frozen, to a temperature of about 15° F. (—9.44° C.) for permanent storage. Others use the latter temperature exclusively, while there are those who prefer 18° to 22° F. (—7.78° to —5.55° C.). The New Zealand department of agriculture supports the latter view, and their report states that such delicate tissues and small bodies as are found in the case of chickens lose their bloom and contract when kept at 15° F. or below. However, it must not be forgotten that the birds so stored are far more carefully handled and selected than are the promiscuous lots shipped to our storage warehouses. De Loverdo[a] advocates —5° F. (—20.6° C.) for freezing and 15° F. (—9.44° C.) for maintenance, though he states that in consequence of such rigorous temperatures the tissues contract and lose their elasticity.

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[a] Le Froid Artificiel, Paris, 1903.

Methods of Thawing.

Another factor in the final condition of the salable cold-storage fowl is the method of thawing. If the bird directly from the freezer be exposed to air at the usual temperature there is likely to be a condensation of moisture on the outer surface and a consequent degeneration of the tissue and often a growth of molds. Hence, it is necessary to thaw in a current of dry, cool air if this method be adopted. The most common practice is simply to place the birds in a vessel of water at room temperature. An appreciable amount of water is absorbed by the dried meat, thereby adding to the price received, since it is sold by weight, and, to the householder at least, the chicken is sold in a thawed condition. According to the warehouse men the best results are obtained when the frozen birds are packed in small pieces of ice and more than twenty-four hours allowed for thawing.

Appearance of Chickens Stored for Varying Periods.

While conducting certain investigations concerning the changes taking place in foodstuffs when preserved by cold, it has been necessary to examine a number of chickens stored for periods varying from a few days to several years. Contrary to the statements generally made by the trade, there have been noted marked differences between fresh and cold-storage chickens, which differences are apparently progressively dependent upon the time of storage. Even after very short periods of storage in a solidly frozen condition, microscopic examination reveals changes in the muscle fibers. Alterations in the color and texture of the chicken are apparent to the ordinary observer after a few months at low temperatures, and it is with such changes, visible to any housewife, that this paper deals.

FRESHLY KILLED FOWLS.

(PLATES X, XI, AND XII.)

For purposes of comparison Plates X, XI, and XII show different views of a normal, properly killed, fresh fowl. This was a young Barred Plymouth Rock cockerel, 12 weeks old and weighing 700 grams. It had been raised on cracked corn, oatmeal, sweet milk, water cress and grass, was starved for twenty-four hours, and then killed by puncturing the spinal cord from the mouth. The sketch was made about seven hours after death. Plates XI and XII, though not sketched from the chicken shown in Plate X, are from fowls hatched at the same time, fed on like food, and treated in all respects as was the chicken shown on Plate X.

Since the purchaser of chickens for food purposes must ordinarily judge of the quality by the exterior alone, it may be well to note

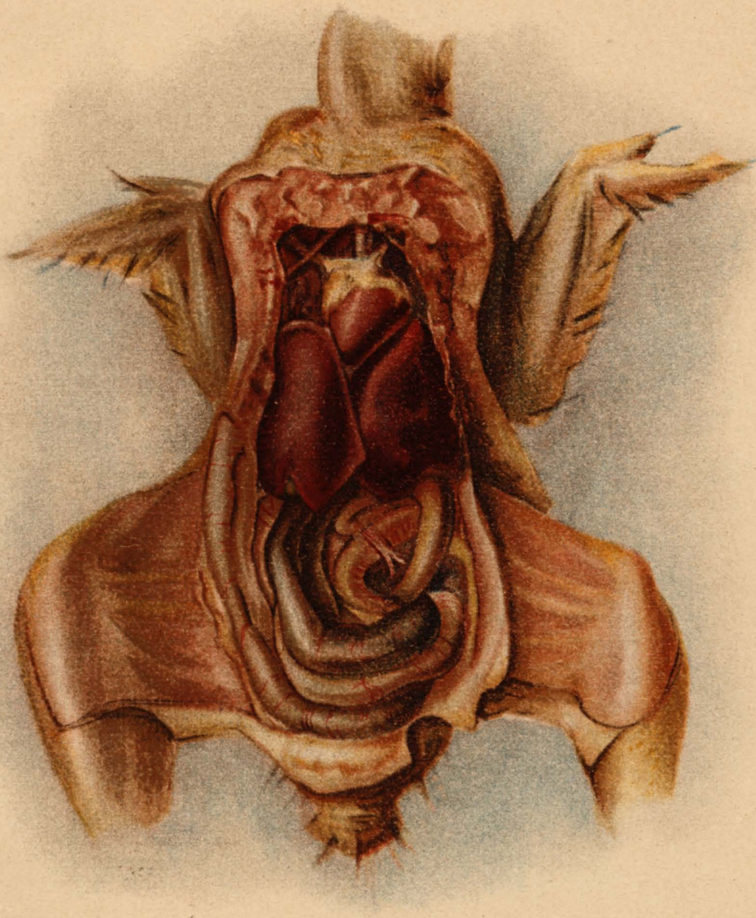
H.M.P.Betts.

FRESH CHICKEN.

THE SACKETT & WILHELMS CO., N. Y.

FRESH CHICKEN. SHOWING SUPERFICIAL MUSCLES AND THE DEEP MUSCLES OF THE BREAST.

THE SACKETT & WILHELMS CO., N.Y.



H.M.P. Betts.

FRESH CHICKEN. ANTERIOR BODY WALL AND GIZZARD REMOVED; LIVER AND INTESTINES IN SITU.

THE SACKETT & WILHELMS CO. N.Y.

certain salient points plainly visible in the case of the fresh chicken which are markedly altered when it has been cold stored for a long period. Probably the most pronounced of these differences is the absence in the fresh fowl of any tinge or suggestion of green in the color of the skin, which is a very pale, soft yellow, with enough translucency to show through it the delicate pink of the muscles underneath. It can be plainly seen, too, that the pink tint is not of the skin itself. While the skin is perfectly flexible and is not adherent over any part of the body, it is well filled by the tissues below, so that areas distended by either fluids or gases are wanting. The feather papillæ are perfectly distinct and, though of the same tint as the skin, are plainly visible because of their elevation. In those regions where the papillæ are most numerous, or support heavier feathers, they lend a much brighter yellow hue to the skin. The neck is smooth and well rounded, the comb and gills red, and the eye full.

Plate XI illustrates the natural color of the fresh muscles as well as the fat. A fresh, well-developed chicken shows very delicately colored muscles of breast and thigh, a soft pink not at all of the cardinal or rose variety, but rather on the salmon shade, which becomes still paler as the muscle thins out. This is well shown on Plate XI, where the muscle of the breast stretches over the ribs and the abdominal cavity. The lack of deep tints in the muscles of fresh chickens is especially striking when compared with those of frozen chickens, even a short period of freezing taking off some of their bloom and iridescence and intensifying the color. The muscles of the inner part of the thigh, though slightly deeper in color, still exhibit the soft pink shades, fading gradually into glistening tendons and separated by well-defined bands of fat.

The color of the fat of a fresh chicken is also characteristic. It is normally a light canary yellow, exceedingly transparent, and with no hint of green.

Plate XII shows the viscera visible after the removal of the anterior body wall, with the exception of the gizzard, which lies just under the lower edge of the liver and almost completely covers the intestines. It was therefore clipped free of the gut, the efferent portion of which is hidden by the liver, the afferent portion being turned upward and outward on the right side, where, in the drawing, its lumen is plainly visible. The position of the intestines is not otherwise altered.

Though this fowl had been starved for twenty-four hours before killing, and the crop was almost empty when it was killed, the intestines were well rounded and showed a brilliant system of blood vessels.

The coloring of the viscera—the bright red liver and heart, the green gall bladder, and the soft yellow fat are all in marked contrast to the pale, delicately colored muscle tissue or the translucent skin of the outer portions of the bird.

COLD-STORAGE FOWLS.

(PLATES XIII TO XVI.)

PREPARATION OF CHICKENS.

The cold-storage chickens which are here illustrated were not in any way specially treated, but were picked at random from the general stock coming to the cold-storage warehouse. They were packed in shallow, rather open wooden boxes, not more than two layers of chickens to a box. In some boxes each chicken was separately wrapped in a heavy, parchment-like paper; in other boxes there was no such wrapping, and the 20 or 30 birds were frozen into a solid mass. None of these chickens had been drawn before storing. Immediately upon their receipt at the warehouse they were placed in a freezer at a temperature of from 13° to 15° F. (—10.55° to —9.44° C.), where they were kept for the periods indicated on the respective illustrations.

That the changes which are here pictured are those which commonly occur after cold storage has been confirmed by the examination of a number of chickens not only from those lots which furnished birds for the drawings, but from others placed in storage at different seasons and from different sources. Medium-sized chickens have been preferred for illustrative purposes, and the fact that all the drawings have been made from fowls of the Plymouth Rock breed eliminates, as far as comparison is concerned, the variation in the texture and skin color that might be attributable to varieties of species.

While the high-class poultry retailer, supplying a fastidious clientele, may thaw his frozen stock in trade by packing in cracked ice, the ordinary dealer, or hotel, or restaurant keeper puts his in a barrel of water, often for ten to twelve hours. This being the common method, it was the one adopted for the thawing of these chickens.

COMPARISON OF ILLUSTRATIONS.

CHICKENS IN STORAGE TEN MONTHS.

Plate XIII shows the musculature of a chicken which has been in cold storage under the conditions described for ten months. While the exterior of this chicken was somewhat dried, the skin less translucent than that of the fresh, and the feather papillæ not quite perfect, it was still a good, palatable-looking bird.

H. M. P. Betts.

CHICKEN IN STORAGE TEN MONTHS.
Superficial Muscles and the Deeper Muscles of the Breast.

THE SACKETT & WILHELMS CO., N. Y.

CHICKEN IN STORAGE TWO YEARS.

THE SACKETT & WILHELMS CO., N. Y.

The muscles show a greater difference, particularly on the inner part of the thighs, where the general tendency to deepen in tint and to develop a leaning toward brownish or purplish tones was most marked. The muscles were soft and tore easily, though the intermuscular fascia was in good condition and permitted of concise dissection. There was, however, a marked drying out of the tissue, and within two hours after the removal of the skin this condition had progressed farther than was observed on the fresh chicken after twelve hours. It was far more noticeable in the outer than in the deep muscle, the pectoralis minor withstanding the action of the air very well.

The fat, as will be seen by comparing Plate XIII with Plate XI, is distinctly a deeper yellow and is becoming opaque.

The viscera were in fairly good condition, though the brilliancy of coloring so noticeable in the fresh fowl has been decidedly dulled and the walls of the intestine have been reduced almost to films. There was no evidence of putrefaction, but there was a slight odor not like that of fresh flesh.

CHICKENS IN STORAGE TWO YEARS.

Plate XIV shows the exterior of a chicken which, with the others in its box, after being in cold storage for about one year, was removed, thawed out, and prepared for the retail trade. As they did not sell promptly, and it was feared that they would be out of condition before they could be disposed of, they were returned to the freezer and kept for another year. At the close of the twenty-fourth month in cold storage a number of chickens from this lot were examined. A typical exterior, as in Plate XIV, is so markedly different from that of the fresh bird that even the most casual observer could not fail to note it. This fowl when frozen weighed 909 grams. After thawing, by immersing in a vessel of water, the weight had increased to 1,015 grams—a gain of 11 per cent.

The texture of the skin was leathery and its elasticity was greatly decreased. It had also a stretched appearance, as though it were too small for the area covered. The translucency was quite lost and the blotchy discolorations were so marked that there was no hint of colored muscles underneath. The ground coloring of the skin contained very little green, which is seen so often in old cold-storage chickens, but its normal pale yellow had been changed to browns, reds, and purples, except over some small sections, as at the end of the breast bone, where the skin lay in close, hard folds and was deep yellow. Each chicken examined from this lot showed on some portion of the body a very noticeable rust-red area. The skin was neither broken nor bruised at these points. In the illustration

(Pl. XIV) the rust-red portion is shown on the side of the breast, where it extended for a distance of 2 inches. Over the prominent bones, such as the head of the femur and the sacrum, the skin was tightly stretched and so closely adherent that even the soaking in water did not loosen it.

While a certain amount of shrinkage had taken place in the chicken preserved for ten months, vastly more in proportion is shown by this chicken kept for two years with one thawing and refreezing. This contraction of subcutaneous muscle and fat has caused the rugose condition of the skin over the breast bone and the deep hollow on the outer part of the thigh. The neck has greatly decreased in diameter and the skin is tightly adherent over the whole length, though rugose.

Very soon after the thawing of this chicken there appeared, especially over such shrunken areas as the one just described, a distention of the skin, due to an accumulation of a slimy liquid and apparently some gas. Puncturing and pressing out the liquid did not prevent its forming and again collecting in very appreciable quantities.

The muscles of this fowl were discolored, shrunken, and so dry in certain places that they had become light brown, fibrous masses. This fibrous degeneration had not, however, penetrated to the deep muscles. The color of the muscles was between the moderate alteration shown by the ten months chicken and the very markedly discolored specimen which had been frozen for three years. The viscera, too, occupied a medium position as to change, the most striking difference being a much-spotted liver and a degenerated intestine. The fluid in the body cavity was in appreciable quantity.

The odor of this chicken was unpleasant, though not that commonly described as putrefactive. After exposure to the air for a few hours the odor was not only increased, but had acquired a similarity to that of putrid flesh.

CHICKENS IN STORAGE THREE YEARS.

Exterior View.—Plate XV shows the exterior of a chicken which had been in cold storage for three years. After thawing, which in this case required from eight to ten hours, though the bird weighed only about 500 grams, the tissues were still so stiff that the position of the bird in the cold-storage box was retained almost exactly. Unlike the chickens previously described, it was stiff enough to hold the posture, even when hung—as in the drawing—for observation, and it kept that position through the whole of the study.

When the drawing of the outer part of the chicken had been finished careful massage loosened the muscles and joints so that it could be stretched without enlarging the original rents in the skin shown

CHICKEN IN STORAGE THREE YEARS.

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CHICKEN IN STORAGE THREE YEARS. ANTERIOR BODY WALL AND GIZZARD REMOVED; INTESTINES AND LIVER IN SITU.

THE SACKETT & WILHELMS CO., N. Y.

in the sketch; by no amount of manipulation, however, could the two sides be made symmetrical.

The most striking difference between this chicken stored for three years and those stored for shorter periods or those which are fresh is this pronounced inflexibility and the general green tint of the skin. The whole appearance of the bird was unpleasant in the extreme. The odor was not that of putrefaction, but was of a sharp, penetrating, unpleasant character having a biting property, which suggested the effect of acrolein on the eyes and nostrils. While this was plainly detected in the unopened bird, the muscles and the viscera gave it far more distinctly, and a decided increase in its intensity was noticed while the study was progressing.

The texture of the skin was such that its original character would never have been surmised. Every particle of elasticity had vanished and its appearance was that of dirty, green, wrinkled parchment. The feather papillæ are seen only as rather darker areas. Where the skin was stretched over the bones it was exceedingly thin and with very little pressure would crack. This fact is illustrated by the bare breast and the projecting appearance of the leg bones, the skin having split on the breast and being ready to split over the folded joints. The eyeball was much sunken, while the comb and gills had practically disappeared.

Muscles and Internal Organs.—In the case of chickens which had been in storage three years, the changes in texture and color of both muscles and fat were especially striking. There was a very marked drying out, particularly of the muscles of the upper breast, so that the larger portion of them had become as parchment-like in character as was the skin and might easily have been mistaken for the skin itself. Below this yellow-tinged dried area the breast muscles present almost a rust red. The gradual paling of the thin muscle as noticed in the fresh chicken was entirely wanting. On the inner part of the thigh the soft salmon pink of the fresh muscle was replaced by colors varying from a deep brown to bluish red, and there was no trace of the original color to be distinguished. Between these muscles the bands of shrunken fat were of a deep brown orange color. No feature of the entire chicken was more striking by comparison with the fresh fowl than this change in the color of the fat.

There was also noticed in this chicken, unlike those which had been previously studied, a very distinct indication, by the discoloration of the abdominal wall, that the viscera had not been removed.

Clipping through the hardened fibers of the pectoralis major and exposing thereby the pectoralis minor, its fibers were seen to be almost, if not quite, as dried out as were those of the outer muscle.

The pronouncedly shrunken character of this chicken was evidenced by the triangular area normally filled by the crop. Not only had this disappeared, but the tissues beneath it—the trachea and esophagus—plainly visible not only in the fresh chicken but in the chicken in cold storage for ten months, had quite disappeared.

For the drawing of the viscera this chicken was prepared as was the one shown in Plate XII. While putrefaction, as far as was indicated by the odor, could not be said to have occurred along the usual lines, the viscera had so softened that even the slightest touch would cause them to seemingly melt, forming a homogeneous semi-solid rather than the characteristic firm, well-contoured organs of the normal fowl.

It will be noticed in Plate XVI that the heart had shrunken and deepened in color. The liver was distorted, many hued, and bore but little resemblance to the normal organ. The arrangement of the intestinal folds was greatly confused, and the removal of the gizzard had to be conducted with the utmost care, since the slightest touch made almost a fusion of the parts over which it lay. The rounding of the intestines was completely gone. They were blotched green, dotted with small points of various colors. The keeping quality of this chicken was practically nil and in a short time the foulness of its odor was distinctly noticeable.

Conclusion.

The changes in the chickens which have been described are not the most pronounced of their kind, other specimens exhibiting more marked degenerations and some showing better conditions. These were, rather, alterations representing as nearly as possible the mean.

Such being the case, the dictum of the warehouse men that there is no change in cold-storage poultry and that it may be kept for an indefinite period can not be accepted in its entirety. Both microscopic study and the taste of the cooked fowl confirm the fact that macroscopically visible degeneration does take place.

Considering the enormous growth and the wide extent of the refrigeration of foodstuffs, as well as the absolute lack of authoritative supervision of such frozen products before they are offered for sale, it seems most desirable that a careful study should be made to determine whether such alterations as have been noted affect the appearance and histological integrity of the flesh only, or whether, as has been asserted by some, the consumption of poultry after long periods of cold storage is not responsible for some of the obscure intestinal disorders and the imperfect metabolism from which modern humanity, especially the dwellers in large cities, are so apt to suffer.

TRAINING COURSES FOR TEACHERS OF AGRICULTURE.

By Dick J. Crosby,

Expert in Agricultural Education, Office of Experiment Stations.

PRESENT STATUS OF TEACHING AGRICULTURE.

Agriculture is taught in every State, Territory, and outlying possession of the United States except Alaska and Arizona, and in these two Territories there are agricultural experiment stations which are extending the knowledge of agriculture among the people. It is taught in one or more of the educational institutions receiving aid from the Federal Government in every State and Territory except Arizona.

As a subject of study in the public schools agriculture is required by law in eleven States.[a] It is definitely outlined in the course of study for public schools published by State departments of education in twenty States.[b] It is encouraged by State school authorities, State agricultural colleges, or other State agencies in twenty-three other States.[c] It is encouraged and taught in the schools of Hawaii, Porto Rico, and the Philippines. There remain only six States and Territories from which information concerning definite encouragement of agriculture in the public schools is lacking, viz, Alaska, Arizona, Delaware, Kentucky, Nevada, and New Mexico.

Forty-three States and three outlying possessions are making some sort of effort to teach their youth the principles underlying our greatest productive industry. Some, it is true, are doing very little beyond experimenting with agriculture in one or two schools or offering tentative elementary courses in agriculture for teachers, but the mere fact that the movement is so widespread and that it is engaging the thought of so many educators is encouraging. No previous educational movement has taken such hold upon both leaders and laity and none is more deeply significant of a growing demand for rural instruction in terms of rural experience.

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[a] Agriculture is required by law to be taught in the rural public schools of Alabama, Georgia, Louisiana, Mississippi, North Carolina, Oregon, South Carolina, South Dakota, Tennessee, Texas, and Wisconsin.

[b] Elementary courses in agriculture have been outlined in the eleven States mentioned above and also in Illinois, Indiana, Kansas, Maryland, Missouri, New Hampshire, New York, Oklahoma, and Wyoming.

[c] These are Arkansas, California, Colorado, Connecticut, Florida, Idaho, Iowa, Maine, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Jersey, North Dakota, Ohio, Pennsylvania, Rhode Island, Utah, Vermont, Virginia, Washington, and West Virginia.

THE DEMAND FOR TEACHERS OF AGRICULTURE.

This movement has gained momentum so rapidly that the supply of trained teachers comes nowhere near filling the demand. The agricultural colleges and larger agricultural high schools get first pick from each graduating class of agricultural students, but can not find enough good men to go round. The State normal schools secure a few of the agricultural college graduates, but it is a significant fact that fully 70 per cent of the teachers of agriculture in normal schools were trained to teach other subjects than agriculture. Hundreds of public high schools and thousands of grammar schools in the several States and Territories where agriculture is beginning to be recognized as a subject of study can never hope to secure teachers who have graduated from agricultural colleges, and yet they want "teachers who know agriculture and know how to teach it." What is being done to meet this urgent demand for trained teachers of agriculture?

TRAINING COURSES FOR TEACHERS OF AGRICULTURE.

Four classes of educational institutions now afford training for teachers of agriculture. These are (1) State agricultural colleges, (2) State normal schools, (3) a few denominational colleges and private schools, and (4) county normal training schools and summer normals.

STATE AGRICULTURAL COLLEGES.

Of the 62 State colleges in which agriculture is taught, 26 now provide training courses in agriculture ranging from summer courses of a few weeks to regular four-year courses with additional graduate work.[a] Four-year courses for teachers are offered by 10 colleges, including colleges for whites in Arkansas, Illinois, Maine, Mississippi, Missouri, and Rhode Island, and schools for negroes in Missouri, South Carolina, Texas, and Virginia. Three-year courses are offered by the North Dakota Agricultural College and by the school for negroes in Florida. The agricultural colleges in Missouri, New York, and North Carolina give two-year courses and the last also offers a one-year course for rural teachers of agriculture. Fifteen of the colleges provide summer schools of agriculture for teachers,[b] four (Massachusetts, Missouri, Pennsylvania, and Utah) cooperate with other agencies, and two (North Dakota and Oklahoma) conduct correspondence courses for teachers. During the year 1906–7

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[a] These include schools for negroes in Florida, Missouri, North Carolina, South Carolina, Texas, and Virginia.

[b] Summer schools for teachers are announced for 1908 at the agricultural colleges in California, Connecticut, Illinois, Kansas, Maine, Massachusetts, Mississippi, Missouri, North Carolina (both white and negro schools), Ohio, Tennessee, Utah, Washington, and Wisconsin.

correspondence instruction in agriculture was given to 83 teachers and summer school instruction in agriculture to 925 teachers.

Several of the universities with which State colleges of agriculture are connected and one separate college of agriculture have regularly constituted departments of education or teachers' colleges, and eight of these offer training courses in agriculture or electives in agriculture upon which full credits for degrees are allowed.

In some of these institutions the teachers' courses are organized on a very broad and thorough basis. The University of Missouri, for example, has a teachers' college in charge of a dean who is also professor of educational psychology. This college affords to advanced students preparation for college and normal-school instructorships, for work as superintendents and principals of schools, and professional training, both theoretical and practical, for teachers in high schools and in elementary schools and for special teachers of technical subjects. Concerning practice work in connection with the instruction of teachers the teachers' college catalogue makes the following statements:

In order to supplement its class instruction in educational aims and methods, and to cultivate skill in meeting the actual problems of teaching and administration, this college has developed as an integral part of its work a system of schools for observation and practice. The professor of theory and practice of teaching is the superintendent of these schools, and he is assisted in the work of supervision by the representatives of departments of instruction who hold positions in the faculty of the teachers' college.

The practical work, required in connection with all courses in theory and practice of teaching, consists of observation, assistance, and class instruction. All students who receive certificates from the teachers' college are required to demonstrate their ability to teach satisfactorily, under normal conditions, so that a certificate is practically a guarantee of efficiency.

Among the technical subjects offered by this college are one in agriculture and one in horticulture for those who are preparing to teach in elementary schools, and one in agriculture and three in horticulture for high-school and academy teachers. In addition, many of the technical courses offered in the college of agriculture may be elected in partial fulfillment of the requirements for the degree Bachelor of Science in Education. The college also offers graduate courses leading to the A. M. and Ph. D. degrees.

The University of Missouri is one of the institutions which annually conduct summer schools for teachers, and it also cooperates with the Columbia Normal Academy in training teachers of elementary agriculture.

In the University of Illinois there is a department of education with ten courses, and in 1907 there was added a special instructor to teach agriculture to prospective teachers. The University of Arkansas offers a four-year normal course in which agriculture and horticulture are taught. The Mississippi College has a department of

industrial pedagogy and offers a four-year course in industrial pedagogy which includes agricultural subjects. The State College of Washington offers ten courses in education, including one course in methods of teaching agriculture. It also conducts a summer school for teachers.

The Massachusetts Agricultural College has a State appropriation of $5,000 for the support of normal instruction and has organized a department of agricultural education. President Butterfield writes that the purpose of the department is "to institute research and to give instruction to students in all those matters which have to do (1) in general with all the various phases of agricultural education, (2) in particular with elementary agriculture suitable for teaching in primary and secondary schools, and (3) with those aspects of the rural school problem which are of special interest in rural social betterment." Continuing, he says:

It is intended that the teaching shall include normal instruction at the college for those students who are preparing to teach in agricultural schools and colleges, and also for teachers desiring to prepare specifically for giving school-garden work and elementary agriculture in primary and secondary schools. It is expected that the department will make a study of technical agricultural education, more particularly on its pedagogical side, including the work of agricultural colleges, agricultural high schools, agricultural courses and subjects in high schools and academies, agriculture in the lower grades of schools, and agricultural extension teaching.

The New York State College of Agriculture at Cornell University offers a highly specialized two-year course in nature study, which is "designed to prepare students to teach elementary agriculture." The work of the first year includes botany, zoology, entomology, physical geography, chemistry, nature study, and elective agriculture; that of the second year botany, zoology, entomology, soils, farm crops, nature study, and elective agriculture. Pedagogical practice is had with children in regular nature-study classes and clubs in the public schools of Ithaca and in school-garden work with children on the University grounds and in the forcing houses.

Hampton Institute, Hampton, Va., may be mentioned among the industrial schools doing effective work in training negro teachers of agriculture. A four-year course is given in which elementary science the first year prepares for agriculture in the three succeeding years. Girls as well as boys study agriculture, which includes both theoretical and practical work—school gardens, farm crops, poultry culture, animal husbandry, dairying, drainage, and irrigation. The training courses for teachers are thoroughly effective. Concerning this feature of the curriculum the Institute catalogue makes the following statements:

The young women, almost without exception, and most of the young men who graduate, engage in some form of teaching. The course of study therefore

provides that all members of the senior class shall receive such preparation for teaching as can be gained during the year from one hour a day spent in observation and a study of principles based upon this observation. In addition to this, all the young women and such of the young men as may so elect gain practical acquaintance with public school work in a course of five hours daily for half a year. In preparation for teaching, a course is given in special methods of teaching reading, language, arithmetic, geography, and nature study. Some time is devoted to psychology for the purpose of acquainting the students with the elementary facts concerning the mind and its activities, and to form a basis for the principles of pedagogy.

Those who take the practical course in public school teaching devote their entire time for half a year to the preparation of lessons, study of methods, and actual teaching. The Whittier School with its four or five hundred children of all ages from the neighborhood offers excellent opportunities for the training of teachers under natural conditions. Each teacher in training is put in charge of a group of children—there may be more than one grade in a group—and is responsible for the teaching and control of the room. The pupil teachers also assist in teaching sewing, cooking, manual training, and gardening. Several members of the class have an opportunity to teach these subjects in a social settlement in the neighborhood. The aim is to give to those preparing to teach, such professional equipment as shall enable them to go into the schools of the South and teach the usual subjects in a strong way, and to introduce such industrial work as may raise the standard of living in the community.

Hampton also offers several graduate courses, among which are agricultural and teachers' training courses. The latter is intended to give—

(1) A more extended academic training than the undergraduate academic course offers, (2) some acquaintance with the principles underlying the best school practice through a study of psychology, pedagogy, school management, and the history of education, (3) actual experience in teaching and managing classes in the Whittier School or at the Institute.

Lincoln Institute, Jefferson City, Mo., is another school for negroes which offers a four-year normal course. A good grammar school course is necessary before a student can enter this course, and two years of agriculture or some other industrial subject are required for graduation. Those who take agriculture spend half the time in the study of the theory as given in the text-book and the other half in the practice and application of the theory to the work on the farm. Two years of practice teaching in the training school are afforded junior and senior students.

Four-year normal courses with instruction in agriculture are also offered by the schools for negroes at Orangeburg, S. C., and Prairie View, Tex.

Noteworthy among the developments of the year are the outlining of four-year courses for teachers at the agricultural colleges in Maine and Rhode Island, of a three-year course at the North Dakota Agricultural College, and of two-year and one-year courses at the North Carolina Agricultural and Mechanical College. Massachusetts has organized a department of agricultural education and held a sum-

mer school for teachers with 212 enrolled. Wisconsin held a summer school for teachers of agriculture with 20 young men enrolled, and plans to continue the work and also to offer agricultural courses in the school of education. Tennessee has added to its staff an assistant professor of agricultural education. Kansas has made definite plans for a six-weeks' summer school in 1908. Sixteen other colleges, which have not hitherto engaged in the training of teachers of agriculture, have made more or less definite plans along this line.

A decided impulse to the work of training teachers in the agricultural colleges has been given by the "Nelson amendment" to the annual appropriation act for the United States Department of Agriculture for the fiscal year ending June 30, 1908. This amendment provides for increasing the funds appropriated by the Federal Government to the several States and Territories for the support of colleges of agriculture at the rate of $5,000 a year until the total sum thus appropriated shall be $50,000 a year. A proviso in the amendment makes it permissible for these colleges to devote a part of the increased appropriation to "the special preparation of instructors for teaching the elements of agriculture and the mechanic arts."

STATE NORMAL SCHOOLS.

There are in the United States 182 State normal schools. From a recent inquiry made by the Office of Experiment Stations it appears that 64 of these schools are now teaching agriculture. Of these, 4 are in Alabama, 3 in California, 1 in Colorado, 2 in Connecticut, 2 in Georgia, 3 in Illinois, 1 in Iowa, 1 in Kansas, 1 in Louisiana, 3 in Maine, 3 in Michigan, 5 in Missouri, 1 in Montana, 3 in Nebraska, 1 in North Carolina, 2 in North Dakota, 1 in Ohio, 3 in Oklahoma, 1 in Oregon, 1 in South Carolina, 1 in South Dakota, 1 in Texas, 2 in Utah, 2 in Virginia, 3 in Washington, 6 in West Virginia, and 7 in Wisconsin.

The instruction in agriculture in 13 of these institutions is confined to the text-book, in 35 the text-book work is supplemented by laboratory exercises, school-garden work, or other practicums, while in the remaining 16 schools the nature of the instruction is uncertain, though it is likely that fully half of these provide practice work.

In 11 of the normal schools agriculture is taught by teachers of agriculture, in 11 by teachers of science and agriculture, in 35 by those designated teachers of science, and in the remaining 7 by other teachers—principals, teachers of pedagogy, economics, etc. Fully 70 per cent of all the teachers of agriculture in normal schools were trained for other lines of work, and of the remaining 30 per cent nearly one-half are burdened with other science work. And yet this is a better showing than one would expect in a movement of such recent origin in the United States.

The normal schools of Missouri have been longer in the field, and, all things considered, are probably better equipped for teaching agriculture than those of any other State. The school at Springfield is less than two years old and has not yet succeeded in getting its agricultural department fully organized, but the other four schools employ teachers of agriculture and provide liberally for laboratory work and other practicums. At Cape Girardeau agriculture occupies a full year, and at Columbia a year's instruction by the regular teacher of agriculture is supplemented by lectures and practicums conducted by teachers of agriculture from the State university. At Kirksville there are two years of agriculture in the undergraduate course and one year in the graduate course, and this work is supplemented by laboratory, school-garden, and field work and by assigned readings and discussions. At Warrensburg agriculture is offered in one course during two terms of the freshman year, in two other courses during two terms of the sophomore year, and in graduate work. Laboratory work covers every part of the course.

In the State Normal School at Jacksonville, Ala., agriculture is taught in the first and second years and horticulture in the fourth year. In a small experimental and botanical garden the students are taught pruning, grafting, budding, layering, and floriculture.

The State Normal School at Greeley, Colo., requires agriculture 4 hours a week throughout the eleventh grade of the high-school course and the eighth grade of the normal-school course, and offers it as an elective in the twelfth grade of the high-school course. It is taught by the associate professor of nature study, school gardening, and elementary agriculture.

Georgia maintains two normal schools which are effective in their work in agriculture. At Milledgeville agriculture is a required subject in the freshman year, and is followed in the junior and senior years by special courses in the study of plants, animals, climate, weather, soils, etc. At Athens agriculture is one of the subjects in the review courses for teachers unable to take the full diploma course. It is also taught throughout the diploma course. In the senior year students recite one double period a week on elementary agriculture, which includes a review of previous work and a study of methods. The school is equipped with a 20-acre farm which furnishes the dining hall with vegetables, milk, and pork and is utilized as a laboratory for the classes in agriculture.

In the normal school at Rockhill, S. C., agriculture has been taught for seven years, largely in connection with a propagating house and school gardens. Recently an agricultural college graduate has been put in charge of the work, and courses in horticulture, floriculture, and dairying have been added.

The examples cited are fairly representative of the work of the better normal schools offering text-book work in agriculture sup-

plemented by laboratory and field practicums, but no account of the work of the normal schools would be quite fair without mention of the fact that many of those which make no pretense of teaching agriculture are really giving more effective instruction in the principles and practice of the farmer's vocation than are some of the schools which mention agriculture in their catalogues. The writer has in mind one normal school in New England where the students get thorough and practical instruction in plant production, from selecting the seed to harvesting and marketing the crop, banking the proceeds, and checking out the money to pay expenses. This work is closely correlated with reading, spelling, composition, arithmetic, geography, drawing, manual training, and civics. It is called nature study and school gardening, but it is much more than that; it is broad, liberal training in the business of life, and that is what agriculture in the public schools should be for the farm boy.

PRIVATELY ENDOWED COLLEGES AND SCHOOLS.

Among privately endowed institutions, Tuskegee is doing work very similar to that of Hampton in training negro teachers of agriculture. There are also a number of smaller schools for negroes which are training teachers of agriculture, and a number of denominational colleges for whites which offer normal courses with agriculture. Among the latter are Bellevue College, Bellevue, Nebr.; Cotner University, Bethany, Nebr.; Grand Island College, Grand Island, Nebr.; York College, York, Nebr.; and Mount Union College, Alliance, Ohio.

COUNTY NORMAL TRAINING SCHOOLS AND SUMMER NORMALS.

Few of the rural elementary schools have been able to employ teachers with any sort of training in the business of teaching except that gained by practical experience. In order to give prospective teachers a little training near at home at small expense, Michigan, Nebraska, New York, Wisconsin, and probably other States have resorted to county normal training schools, summer normal schools, Chautauqua assemblies, and other like short courses in training. Essentially the county normal training schools are high schools in which, during one or two years, the rural school subjects are reviewed and some practice in teaching them is afforded. All of the schools of this class in Michigan, Nebraska, New York, and Wisconsin are supposed to teach elementary agriculture, but the time available is so short that little more than text-book work has been attempted thus far. Nebraska also maintains summer normals known as "junior normal schools," in which agriculture is taught. In New York, Pennsylvania, and the Middle West numerous Chautauqua assemblies are held in summer, and many of these are now giving some attention to agricultural subjects for teachers. In Pennsylvania, for example, the State college, cooperating with the State superintendent of public

instruction, will give instruction in agriculture in Ebensburg and Mount Gretna in 1908.

SUMMARY OF THE STATUS OF TRAINING COURSES IN AGRICULTURE.

From the foregoing it appears that there are now in the United States upward of 100 colleges and normal schools, besides many (probably 100 to 125) lesser training courses and summer schools, where prospective teachers may find some instruction in agriculture and some guidance in teaching it. The State agricultural colleges and the State normal schools are the leading institutions engaged in this work. Forty-two per cent of the agricultural colleges now offer courses for teachers of agriculture, but nearly one-third of these have been compelled thus far to confine their work to short courses in summer. Thirty-five per cent of the normal schools offer work in agriculture; two-thirds of these supplement the text-book work with laboratory work and other practicums, and one-third confine themselves to the text-book. The work of the agricultural colleges is strong on the side of technical agriculture and weak on the side of training; that of the normal schools is relatively stronger on the side of training courses. The surprising and encouraging thing in the whole situation is that so much progress has been made in the few years of agitation, and that so many institutions are planning to develop training courses for teachers of agriculture in the near future.

There seems to be almost no opposition to the movement among the 245 leading educators who were consulted in this inquiry. On the contrary, nearly all expressed their warm approval of the present tendency to give direction and concreteness to the teaching in rural schools by drawing largely upon the home experiences of the pupils for problems and illustrations. Many also recognized the duty incumbent upon the agricultural colleges and normal schools to prepare teachers along somewhat different lines than formerly, though some frankly confessed their inability to cope with the situation under present conditions. Only two of those who expressed opinions were opposed to the development of training courses in agriculture in their institutions, and one of these based his opposition on the fact that his school was located in a city and had enough to do to train teachers in city school subjects.

THE ESSENTIALS OF TRAINING FOR TEACHERS.

Having reviewed the present status of agricultural teaching in this country it now seems appropriate to consider briefly the nature of the work that teachers of agriculture will be called upon to do and the essentials of training for such work.

Teachers in the rural elementary schools will be expected to direct the nature-study work of the first six or seven years, including school

and home gardens, and to teach elementary agriculture during one or two years. This should include the mastery of an elementary textbook of agriculture, simple laboratory exercises with soils and plants, some practice in identifying types of farm animals and in caring for these animals at home, and home-garden or field-crop work involving some consideration of the selection and testing of seed, methods of culture, the comparison of yields, and the utilization of the products.

In the nontechnical secondary schools where agriculture is taught teachers will be called upon to give more advanced instruction in agriculture, which will involve some knowledge of the principles of botany, chemistry, and physics. Agriculture will include some study of the physiology of cultivated plants, the influences of heredity and environment upon them, soils, and other physical and biological agencies in their relations to crop production, breeds of animals, the principles of feeding, the care and handling of milk and its products, diseases and insect pests and how to combat them, farm machinery, farm records, and other like topics. The laboratory exercises and field work will deal more with underlying principles than it is possible to do in the elementary school, and more attention will be paid to giving the students problems to work out in the orchards, fields, and barns at home. As a rule one teacher of agriculture will have to direct all of this work.

In the technical agricultural high schools the instruction in agriculture will be more comprehensive and there will be the further advantage of a good equipment in laboratories, fields, and barns, and a corps of agricultural teachers, each a specialist in some phase of the subject. In these institutions there will be opportunity to teach not only the principles of the science of agriculture, but also much of its practice. There the students will have opportunity under expert guidance to acquire some skill in judging and feeding live stock, in operating the dairy and the creamery, in handling improved farm machinery, and in the other work of a modern well-equipped farm.

The work of the agricultural college is still more advanced—more scientific. Advanced botany, chemistry, physics, zoology, entomology, and bacteriology are taught, and the science of agriculture is emphasized more than the art. Usually a previous knowledge of farming operations is assumed, and the time of the students is devoted to acquiring a thorough knowledge of the broad underlying principles of agriculture. They have opportunities to familiarize themselves with the research work of the agricultural experiment stations and of this Department, with the history of agriculture and the great agricultural problems of the day, and with the business of agriculture in its relations to manufacturing, commerce, and other business operations.

With reference to the training required by teachers in these different classes of institutions, it is evident that widely different standards must be fixed; but as regards the underlying principles of training,

there is a common ground. Prof. Paul Hanus, of Harvard, recently discussed this question before a body of teachers and said in effect that the object of professional training for the teacher is to insure a high degree of efficiency at the outset of his career, progressive skill in teaching, a broadening and deepening interest in and insight into his profession, and hence constantly increasing professional usefulness. Such training, he maintained, includes (1) adequate scholarship; that is, scholarship which is at once broad and at the same time deep in one field at least; (2) technical training, the study of the accumulated knowledge of his profession, of its history, theory, and practice; and (3) some practical experience, under the guidance of skillful teachers, in the application of the knowledge thus acquired.

With reference to the training of teachers of agriculture, how are our educational institutions measuring up to these specifications? Most of our agricultural colleges are clearly in a position to furnish the opportunity to acquire scholarship broad in general and deep in agriculture; but what of technical training in the history, theory, and practice of teaching, and what of practical experience in teaching under skilled guidance? Several of the agricultural colleges are in a position to impart instruction in the history and theory of pedagogics, but comparatively few of them are prepared to give teachers practice in their profession. The agricultural colleges in Missouri and New York are notable exceptions.

Lack of attention to this almost vital point in the training of teachers in colleges where teachers' courses are offered is doubtless due to the press of other work which for the time at least has seemed more important. There is no reason to believe that it is due to underestimation of the value of such training, nor has it arisen from a lack of facilities for practice teaching. Nearly every college affords opportunities in its own class rooms for its seniors and graduate students to acquire practice in teaching elementary agriculture and in conducting practicums, and many of the colleges have elementary schools, either on or near their campuses, which would be much benefited if the college faculties would utilize them as practice schools for elementary teachers in training. With the more liberal financial support afforded by the "Nelson amendment" and the provision that a part of the money thus provided may be used in training teachers of elementary agriculture, some of the agricultural colleges have already begun to organize faculties and provide adequate facilities for such training, and doubtless many others will make similar provisions in the near future.

The State normal schools are in the main better equipped and more experienced than the agricultural colleges with reference to providing professional training for teachers. No good normal school is content to get along without a training school, and most of those

considered in this inquiry are provided with such schools. They are also well equipped relatively to impart instruction sufficiently broad for teachers in secondary and elementary schools; but when it comes to depth of technical training in agriculture, comparatively few are plowing much below the surface; few are heeding the agricultural maxim, "plow deep." This is due mainly to lack of teachers having the agricultural outlook. We have seen that not more than 30 per cent of the normal schools offering courses in agriculture have special teachers of agriculture, and it is a notable fact that many of these teachers have not had special training in agriculture.

This is a serious weakness and is so recognized by normal-school principals who have compared the agricultural teaching of such teachers with that of instructors in some of the better agricultural colleges. Teaching agriculture is much more than teaching a conglomeration of physical and biological sciences. Educators are coming to see more and more clearly that agriculture is both a science and an art, and as a result it is being taught in ways which are not strictly applicable to the teaching of any of the other sciences. It is coming to demand its own peculiar apparatus, which may be extremely simple and inexpensive, but yet differs from that used in chemical, physical, or botanical courses. It should also have its outdoor laboratories—the school garden, the school farm, and the flocks and herds of domestic fowls and animals. How will the old-time teacher of physics, chemistry, or zoology use these? Teachers whose training is technical and deep in the "new agriculture" are essential to the best success of normal school work in agriculture.

With such teachers in charge of students preparing to teach in our public schools, we shall no longer find agriculture taught merely as a text-book subject; rather will it draw upon every item in the farm inventory and every activity of the farm boy's life for problems, demonstrations, and illustrations. And these students when they go out to take charge of schools attended by farm boys will make similar use of country-life material. The demand for elementary agriculture carries with it a demand for a new and better way of teaching country children; for a common ground whereon text-book and teacher and pupil may meet and the latter may understand the other two; for a country school wherein country children may be taught in terms of country life and may come to have an intelligent appreciation of the information open to them in later life from the agricultural experiment stations and the United States Department of Agriculture.

Just now the whole agricultural education movement is in a condition of rapid though rather chaotic development. The country school appeals to the county normal school and the State normal school for teachers having the country-life outlook; the normal schools supply a few emergency-trained teachers and call upon the agricultural

college for expert assistance, and the agricultural college at the very best can only go a little way toward supplying the assistance needed. All of these agencies are striving to the utmost to supply properly trained teachers, but their combined efforts do not avail in the present emergency, to say nothing of preparing for future needs.

The task of preparing teachers for the country schools is an enormous one. Take for example the State of Wisconsin, with its agricultural college, 7 State normal schools, and 10 county training schools, all of which are training teachers of elementary agriculture. If from this time on all of the graduates of all of these institutions should engage as teachers in rural elementary schools, it would take seven years at the present rate of graduation to supply each school with one teacher. In 1906 there were 11 graduates from the State college of agriculture, 647 from the State normal schools, and 231 from the county training schools for teachers. It is not likely that any of the graduates from the college of agriculture went into the rural elementary schools and probably not more than one-third of those from the State normal schools. Assuming that 215 graduates from the State normal schools and 230 from the county training classes went into these schools, it would take at this rate fourteen years to supply one teacher for each of the 6,439 rural elementary schools in the State. Verily there would not be much danger of an over supply of trained teachers of elementary agriculture in Wisconsin if all of her State educational institutions were to devote their energies to this one field of endeavor. And Wisconsin ranks well to the front in facilities for training teachers.

LINES OF FUTURE DEVELOPMENT.

If we may forecast the future from the present and the past, from the momentum quickly gained by the movement for teaching elementary agriculture in the rural schools and from the disposition on the part of educators and others to accelerate rather than retard this movement, we shall arrive almost inevitably at the conclusion that the educational institutions upon which has been placed the burden of preparing teachers are clearly called upon to furnish more trained teachers of agriculture. We are also led to believe that for many years to come the demand for teachers of agriculture commanding only moderate salaries will be so great that both agricultural colleges and State normal schools will feel called upon to do some elementary work in agriculture in special short courses and in various forms of extension work. How the remainder of the field will be divided is a question hardly within the province of this paper to discuss, but a suggestion or two with reference to the writer's notion of a proper division might not be out of place.

In the first place, we believe that the main business of the agricultural colleges in this field should be research in agricultural education and the preparation of teachers for the more advanced work in agriculture, i. e., for the colleges, the agricultural high schools, the State normal schools, and the public high schools employing special teachers of agriculture. The agricultural colleges should also cooperate freely with the State normal schools, through interchange of instructors when this is feasible, and in conducting teachers' institutes, summer schools, and extension work among rural schools.

Secondly, the main business of the State normal schools—agriculturally—should be to prepare teachers for the secondary and elementary schools. They will not prepare special teachers of agriculture, but teachers of science, including agriculture, and all-round teachers whom they can give considerable insight into agriculture and some training in rational methods of teaching it. They will also cooperate with the agricultural colleges as indicated above and will exercise a strong influence over the county normal training schools, which are now rapidly growing in numbers and in popular favor. These county schools look to the State normal schools for their principals, who usually teach pedagogy and other special subjects—sometimes agriculture. If the State normal schools are in a position to give strong courses in agriculture to students preparing for such principalships, we shall soon see something more than mere text-book work in these lower training schools.

Finally, to the county normal training schools will fall the work which comes closest home to the hearts and homes of the rural people—that of giving the only professional training which the great majority of young teachers will have before undertaking the early education of the farmers' boys and girls. Probably there will not be an opportunity in these schools to give much training in agriculture, but there will be an opportunity, if the training has been right all the way down through the agricultural colleges and the State normal schools, to give these young teachers a wholesome view of country life and such an outlook upon nature-teaching as will revolutionize country schools. How important that the training for teachers be right all the way down, and that all the institutions engaged in this work receive liberal support and encouragement.

THE ART OF SEED SELECTION AND BREEDING.

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INTRODUCTION.

There is no one subject related to farming of greater interest and importance to the farmer than the improvement of his general crops by seed selection and breeding. The study of these plants from the breeding standpoint is not only intensely interesting, but it also usually results in awakening a keener interest in all phases of crop production, from the preparation of the soil for the seed bed and the cultivation of the growing plants to the marketing of the products. This subject is of vital commercial importance, from the fact that it usually costs no more to grow improved varieties of farm crops than unimproved sorts, while the increase in production due to the use of improved seed results in additional profit. The originators and growers of improved varieties not only have the satisfaction of having made the growing of these crops more profitable by reason of improved quality and increased yields, thus benefiting everyone interested in their production and consumption, but they usually also reap an additional financial reward from the sale of the seed or plants of their improved varieties.

During the past ten or fifteen years there has been a great awakening of interest in the subject of seed selection and breeding as applied to our great general farm crops, especially corn, cotton, tobacco, wheat, oats, and other crops of wide distribution and cultivation. One reason for this awakening is that the land on which these crops are grown has increased in value to a very marked extent, and it is necessary to increase the production per acre and improve the quality of the crops in order to make farming profitable. Illustrations of this fact can be found in almost every agricultural community. For instance, some of the corn land of central Illinois was bought by settlers within the last fifty years for less than $10 an acre. This land is now valued at $125 to $150 an acre. On this high-priced land it is necessary to grow more productive crops than formerly in order to make a reasonable profit on the present investment.

Another primary reason for the awakened interest in seed selection and breeding lies in the fact that in the sections where crops have been

grown for a considerable time the varieties produced on these lands year after year, where no seed selection or breeding has been practiced, have tended to run out and become unprofitable. In addition to the running out of varieties under conditions of continuous propagation without breeding, fungous diseases and insect enemies frequently develop to such an extent that, unless resistant or immune varieties are secured by seed selection and breeding, the growing of these crops is either carried on with small return to the growers or has to be abandoned.

The settlement for farming purposes of lands not heretofore occupied has made necessary the production of new varieties of crops adapted to the peculiar conditions of soil and climate of these regions. The use of unsuitable varieties has usually resulted in partial failure and disappointment, and the profitable growing of crops on these new lands has depended on the production of varieties adapted to their conditions.

The new uses for farm crops that are constantly being discovered and the demands of the consumer for these new products are resulting in the increased production of crops for special purposes. As an illustration of this fact it may be mentioned that the manufacture of cigars has developed to such a point as a result of the discriminating demands of consumers that, instead of a cigar being made throughout of one kind of tobacco, we now have growers producing certain varieties of tobacco for cigar wrappers, others for fillers, and still others for binders.

The profitable growing of the general farm crops is of the greatest importance because of the large number of farmers dependent upon their production. Any improvement resulting from seed selection and breeding is therefore of the greatest benefit because of its far-reaching effect. The importance of the improvement of these crops is fundamental, not only as regards the prosperity of the individual grower, but that of the country as a whole, because the production of these general crops is the foundation of the Nation's prosperity.

In the improvement of varieties our general farm crops have not advanced as rapidly as the more intensive crops, partly because of lack of specialization in their production. The necessity for seed selection and breeding with these crops has not been so apparent; but, with the introduction of intensive, specialized, and more profitable methods of farming, the interest in this subject has become as great as in the case of fruits, flowers, and live stock.

The necessity for new and improved varieties developed by seed selection and breeding, both in the agricultural sections now under cultivation and in newly settled areas where the land is being brought into the cultivation of farm crops, has attracted the attention of everyone interested in the problems connected with these conditions.

As a result of the demand for help in securing improved varieties of crops adapted to special soil and climatic conditions and capable of producing the largest returns for the expense and effort put forth in their production, and in view of the great opportunity for work of this character, many agricultural investigators have had their attention directed to this field.

THE ART AND THE SCIENCE OF BREEDING.

The art of seed selection and breeding as here used means the practical application of methods of breeding to the production of improved varieties of plants for commercial agricultural purposes. The term "science of breeding" is used to define the work of the investigator in determining by means of experiments the principles relating to the different problems of breeding. The scientific investigator's work may result in valuable additions to the knowledge of the subject of breeding, while the investigations may not of themselves be commercially profitable. However, the results accomplished by the investigator may be applied by the breeder in the actual work of improvement. The work of the investigator from the scientific standpoint is the discovery of the principles of breeding, which the practical breeder may not have the training, the time, the opportunity, or the means to discover. The breeder, working necessarily with a limited number of crops under local conditions of soil and climate, develops new and improved varieties adapted to these conditions, while the scientific investigator, with a broader field for observation, may correlate the facts developed by many breeders and establish principles applicable to all conditions.

It is necessary, then, to distinguish clearly between the art of breeding and the science of breeding, although the object of both lines of work is the same, viz, the modification and improvement of plants for the use of man. The investigations and observations of Charles Darwin established the principle of the variability of plants under cultivation and the influence of continued selection in the origin of species. Although Darwin did not himself produce any new varieties or species of plants for cultivation, much of the recent practical work of the breeder in the improvement of cultivated plants has been based upon the principle he announced. Most of our important cultivated varieties of crops have been produced by men who have not developed the principles of breeding, but have used the knowledge obtained from investigators into the origin of varieties of plants. In other words, the plant breeders apply the facts worked out by the scientific investigators in the production of new and improved varieties of crops.

The careful and exact experiments of the investigator and the keeping of the necessary records require men who are specially trained

and who devote their time and energy exclusively to this purpose. The origin of valuable commercial varieties by practical breeders has for the most part been accomplished by men who have neither had the training necessary for scientific investigation nor the time and opportunity to make the broad observations required in the study of the principles of breeding. It has often happened that when workers have attempted to carry on both lines of work they have failed of any high achievements in either line. The art of breeding is the work of growers who, by long experience with the crops from a commercial standpoint, become accurate judges of the value of plants for cultivation and economic propagation.

THE PURPOSE OF SEED SELECTION AND BREEDING.

The object of seed selection and breeding is the production of new or improved varieties of crops adapted for profitable commercial growing. The discussion of this subject in this connection will be confined to the general farm crops propagated from seed, although the principles involved apply to a greater or less extent to all cultivated plants. The average yield per acre of the cultivated varieties of our farm crops is small compared with possibilities when better seed and improved varieties are used. The causes of this low average yield are many, but among the most important are the use of seed of weak vitality, resulting in a poor or uneven stand, the growing of a large proportion of inferior and unprofitable plants, and the use of varieties not adapted to local conditions of soil and climate. If the work of breeding could be extended in the case of farm crops to the origination of varieties possessing stronger germinative power, producing more uniformly productive plants, and adapted to the conditions of soil and climate under which they are to be grown, the profitableness of these crops would be greatly increased, with little additional effort or expense.

The object of the breeder should be the finding of the best plants in the variety with which he is working, the propagation of these plants under conditions favorable for the fixing of the desired characteristics, so that they will come true to type under ordinary methods of cultivation, and the securing of reliable seed for planting.

FIELDS OF WORK FOR THE BREEDER'S ART.

ADAPTATION TO CLIMATIC AND SOIL CONDITIONS.

The acclimatization of the varieties of crops to the conditions of soil and climate where they are grown is one of the most important fields for the breeder. The farmers suffer great annual loss from the growing of varieties of crops not adapted to their local conditions, and there is a growing demand for the production of varieties

adapted to the soils and climatic conditions of each region where crops are grown. The range of adaptability of varieties has never been determined so that with known soil and climatic conditions growers can intelligently buy seed for planting. However, with more knowledge of the relation of the different types of soil to the different varieties of crops, it will be possible for the breeder to produce and distribute seed specially adapted to particular sections.

An illustration of the inadvisability of using varieties not adapted to soil and climatic conditions is found in the experience of growers of Sumatra tobacco under shade in the Connecticut Valley. The seed of this variety of tobacco secured from Florida and Sumatra and sown in the Connecticut Valley in 1901 and 1902 was found to break up into several distinct types, some of which were desirable but most of which proved undesirable and unprofitable for cigar-wrapper production. The proportion of desirable types was small, and the difficulty of sorting them out from the undesirable types in the crop was so great that the growing of this variety was found to be unprofitable.

A careful and systematic study of the Connecticut fields of plants from Florida-grown seed revealed the presence of a large proportion of the several undesirable types of plants. The use of proper methods of seed selection and breeding enabled the growers to propagate the different types which were true to seed and to eliminate the unprofitable types of plants.

The seed of the variety of tobacco brought to the Connecticut Valley in 1903 from Cuba and used for cigar-wrapper production was found to exhibit the same characteristic breaking up in type (Pl. XVII, fig. 1) observed in the case of the Sumatra variety, and it was not possible to grow this variety profitably until seed of the desired types (Pl. XVII, fig. 2) was saved free from crossing. In this way the freaks, reversions, and other undesirable and unprofitable types of plants which developed as the result of the change of seed were eliminated. If the valuable types of these varieties had been secured by breeding and adapted to the soil and climatic conditions of the Connecticut Valley for commercial production, the loss due to the use of unimproved varieties could probably have been avoided.

An illustration in the experience of the writer of the opportunity of the breeder in the production of acclimated varieties adapted to a particular purpose is the introduction into the Connecticut Valley of hairy vetch (*Vicia villosa*) for cover-crop purposes. In this region it is desirable to sow a cover crop on tobacco lands immediately after the tobacco crops have been harvested, to prevent loss of soil fertility from washing or other cause and to furnish vegetable matter for turning under at the time of the preparation of the fields for

the next season's tobacco crop, in order to add to the humus content of the soil. The crop used for this purpose heretofore has been rye, which is objectionable because, owing to the woody nature of the plants, they do not rot quickly when plowed under, thus interfering with the conservation of soil moisture for the use of the following tobacco crop.

At the suggestion of Dr. B. T. Galloway, the writer secured European-grown seed of hairy vetch, a legume that in many ways is ideal for cover-crop purposes. This imported seed was sown in the Connecticut Valley in the autumn of 1904, but only a small proportion of the plants were hardy enough to live over the severe winter. The seed from these hardy plants was saved and planted in 1905, with the result that a larger proportion of plants lived through the winter than the preceding season. Again seed was saved from the hardy or winter-resistant plants, and it was found during the past two seasons' tests that a hardy variety of hairy vetch adapted to the climatic and soil conditions of the Connecticut Valley had been secured.

This acclimated variety is of special importance from the fact that it not only prevents loss of soil fertility during the time when the tobacco crop is off the fields, but adds to the nitrogen content of the soil through the action of the nitrifying organisms that live and work on the roots of these plants. It has been necessary heretofore to buy large quantities of nitrogen in the form of commercial fertilizer for this purpose, a part of which can now be secured at less cost through the use of this acclimated legume cover crop.

The introduction and breeding of drought-resistant varieties of wheat, such as the macaroni wheats, adapted for growing in the semiarid regions of the Northwest, is another striking example of what has been accomplished in this field of breeding and seed selection. The use of these varieties has resulted in the profitable growing of wheats where it was not possible to cultivate crops heretofore and has added to the productive area of the United States.

The New England farmers have found that it is more profitable to grow a dent variety of corn for feeding purposes than the flint varieties which have heretofore been grown for this purpose. The dent varieties not only produce a larger yield, but have a higher feeding value than the flint corn. The difficulty with the dent varieties grown heretofore has been that the productive sorts would not mature in the short season of New England; consequently, the growers have been compelled to send to western sources for seed every year. In 1905 the writer secured special ears, grown in Illinois, of the Reid's Yellow Dent, an early maturing variety of dent corn, and planted this seed on the farm of Mr. N. S. Brewer, at Hockanum, Conn. The first season only a few ears matured fully. These were

FIG. 1.—A FIELD OF CUBAN TOBACCO GROWN IN CONNECTICUT FROM IMPORTED SEED, SHOWING THE BREAKING UP IN TYPE DUE TO CHANGE OF CLIMATIC AND SOIL CONDITIONS.

FIG. 2.—A FIELD OF CUBAN TOBACCO GROWN FROM SEED SELECTED FROM DESIRABLE PLANTS SHOWN IN FIGURE 1, SHOWING UNIFORMITY OF TYPE SECURED BY SUCH SELECTION.

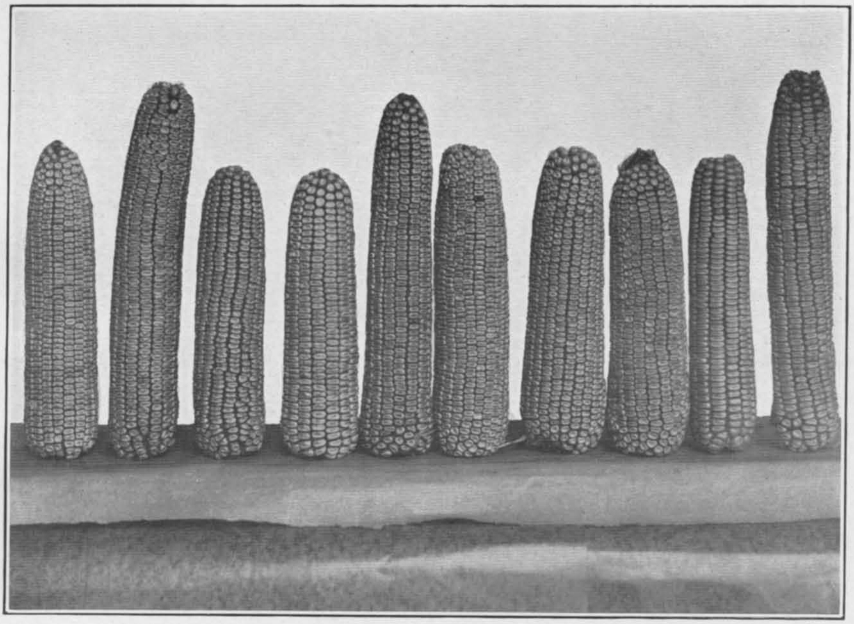

FIG. 1.—TEN EARS OF BOONE COUNTY WHITE CORN FROM THE SAME FIELD, SHOWING GREAT VARIABILITY IN TYPE RESULTING FROM FAILURE TO SELECT SEED.

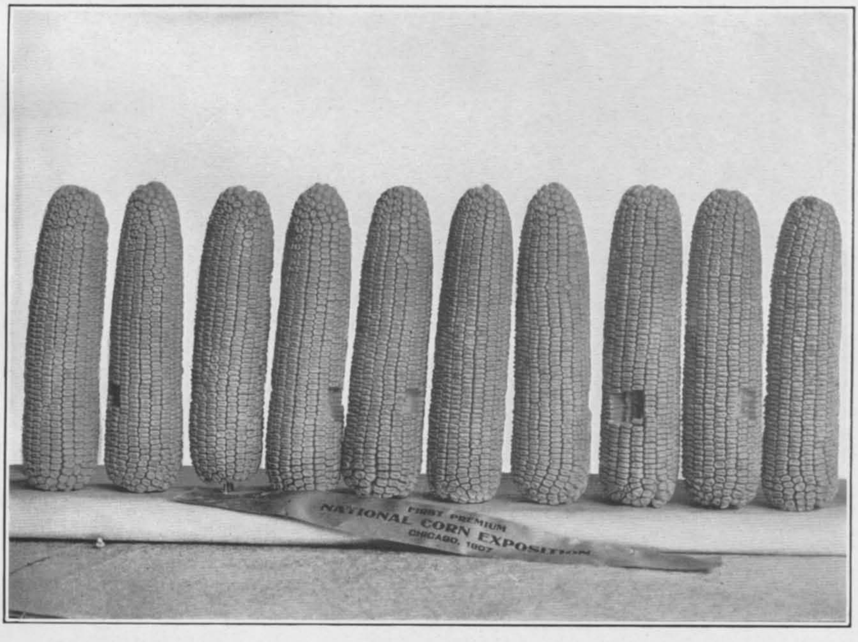

FIG. 2.—TEN EARS OF THE SAME VARIETY OF CORN SHOWN IN FIGURE 1, ILLUSTRATING THE UNIFORMITY IN ALL DESIRABLE CHARACTERS ATTAINED BY THIRTY-TWO YEARS OF SEED SELECTION.

carefully selected and saved for planting the following season. In 1906 this seed was planted in a large field on the same farm and yielded 121 bushels of mature shelled corn per acre—more than double the yield of flint corn grown on this farm under the same conditions. The earliest and best ears were again saved for planting in 1907. The season was unfavorable for corn growing in Connecticut, but the crop of the dent variety produced 71 bushels of shelled corn per acre, while flint varieties grown under the same conditions produced only about 35 bushels. Not only was the yield of shelled corn of the dent variety more than double that of the flint variety, but the yield of the stover from the dent corn was about double that from the flint corn.

THE PRODUCTION OF MORE UNIFORM VARIETIES OF CROPS.

The most important field for the breeder's work is in the improvement of the established varieties of crops by the production of strains approximating more uniformly to the best types of these varieties. This lack of uniformity in high productive capacity is responsible in great measure for the present low average yield of most of our crops. It is due to the variability of the plants of these varieties, which is more evident in the cross-fertilized crops than in the self-fertilized ones. In the case of corn this variability of plants is particularly striking (Pl. XVIII, fig. 1). It is the experience of most corn breeders that it is not possible to produce on an acre more than 5 bushels of uniform ears even of our most improved strains. A large majority of the plants produce ears of small size, irregular shape, and light weight, which are undesirable. Many of the stalks are barren. Only a small proportion of the plants produce the maximum size and weight of ear. In the cornfields of the central Mississippi Valley the corn is usually planted in hills, 3 feet 6 inches apart in the row. The rows are arranged 3 feet 6 inches apart and the hills checked so as to permit cross cultivation. This arrangement provides for 3,556 hills to the acre. An average of about 3 kernels is planted in every hill. If every kernel produced a uniform plant and the plants bore uniform ears weighing 1 pound each, the yield per acre would be about 10,668 pounds, or about 155 bushels of shelled corn per acre. The fact that the average yield of this section is less than 40 bushels per acre is striking evidence that only a small proportion of the plants bear ears of the maximum weight.

A thorough study of ears of the cornfields in many places in the corn belt by the writer during the past ten years has shown that only a small percentage of the plants produce the best returns possible under the conditions of soil and climate in which the varieties have been grown.

Considerable of this variability and lack of uniformity of the corn plants can be overcome by systematic selection of the best seed ears

year after year and the propagation of this seed free from crossing with the undesirable types of plants or inferior varieties of corn (Pl. XVIII, fig. 2). This fact has been fully proved in the production of varieties by many years of continued selection by corn breeders of the seed which has been found to be more productive and profitable for culture than the unselected or unimproved sorts. The gradual increase in yield of corn in Illinois, Iowa, and other great corn-growing States during the past ten years can safely be attributed in no small degree to the use of the improved varieties produced in these sections by breeders.

The cotton crop of about 12,000,000 bales is produced on about 30,000,000 acres. The average yield, therefore, is less than one-half bale per acre. This low average yield is due in part to the fact that a majority of the plants of the varieties now grown do not produce a yield equal to that of the best plants in the fields. The variability of the cotton plants in respect to the amount of cotton borne by the individual plants is almost as marked as the variability of the corn plants. Not only is there great variability as respects the yield of cotton from individual plants, but there is a corresponding variation in the character of the lint borne by the different plants. It is the opinion of many of the most successful growers that if the cotton varieties now grown were improved so that the plants conformed more closely to the standards of the best plants in the fields, the yield of cotton from these varieties would be doubled without much additional expense in the cost of production.

In a careful study of tobacco plants of the present varieties during a period of five years, the writer is convinced that the variability (Pl. XIX, fig. 1) of the plants of these varieties is chiefly responsible not only for the low average yield but for the inferior quality of many of these varieties. This variability of the tobacco plants of some varieties, as, for instance, those used for cigar wrappers, makes it necessary for the different types to be sorted into their respective grades by trained workers at great expense.

The variability of all crops is so great that the field for securing improved and more uniform types is very wide and extends to every community where these crops are grown. The methods to be used in securing improvements depend to a greater or less extent on the natural habits of fertilization of the crops and must be modified to meet these conditions.

The work of producing improved strains of existing varieties can best be done by the growers of these crops on their farms. The improved varieties of corn, tobacco, wheat, and other crops which have

been produced under these circumstances are strong evidence of the desirability of further and more extensive breeding work by the growers.

ORIGINATION OF NEW VARIETIES.

The production of new varieties is the most attractive field for the breeder, though of less importance than the development of uniform and more productive types of the existing varieties. In the origination of new varieties, variability is not only desirable but necessary, and one of the aims of the breeder is to make plants vary in order to find new and ideal plants as the basis for the development of new varieties.

Among the means for inducing this variability, two are of the greatest possible practical importance. The first and most effective is the change of seed from one set of conditions to others markedly different. As a rule the greatest variability is induced by changing the seed from the most favorable to less favorable conditions of soil and climate. The conditions favorable to the production of variability, and therefore to the finding of new types of plants, are not always the most favorable for the commercial production of the crop.

The origin of the "Uncle Sam Sumatra" tobacco serves to illustrate this effect of change of seed and its use in the production of new varieties. The first Uncle Sam Sumatra plants were found by the writer in the Connecticut Valley in 1903 in crops grown from Florida-Sumatra seed. The Florida-Sumatra tobacco was grown from seed secured from the island of Sumatra. When the Florida-grown seed was taken to Connecticut the plants grown from it varied in a marked degree and several new types developed that did not exist in Florida and according to the best information obtainable did not exist in Sumatra. In other words, the change of seed from the favorable conditions for the growth of the parent Sumatra variety in Florida to the shorter season and different soil of Connecticut and to other unfavorable conditions in this northern cigar-wrapper district, produced extreme variability and accounted for the appearance of this type of plant among the other new types.

The Uncle Sam is a new and distinct type of tobacco in every character that has been observed, from the shape and texture of the leaf and the structure, arrangement, and color of the flowers to the habit of growth of the plant. The writer and his associates have carefully searched for this type of plant in Florida fields grown from the variety in which the Uncle Sam type was found, but have been unable to find a single plant of this type.

After the self-fertilized seed of this variety was propagated in Connecticut and found to come true to seed (Pl. XIX, fig. 2),

Connecticut-grown seed was grown in Florida, and there was little or no breaking up of type (Pl. XX, fig. 2). Connecticut-grown seed of this variety sent to Cuba and Porto Rico for trial produced uniform Uncle Sam plants.

A similar result was found in the case of the Hazlewood Cuban tobacco. This variety was produced from a new type of tobacco originated by the writer in Connecticut from Cuban-grown seed. The Connecticut-grown seed of this variety sent to Cuba showed no breaking up of type, as was the case when the Cuban seed was sent to Connecticut.

The production of variability by means of hybridization, either by simple or composite crossing, as a source of new varieties is a subject which as yet is but little understood, and its application for the improvement of farm crops is still very limited. The technique of crossing, the behavior of the hybrid plants, and the methods for their propagation have not as yet been worked out sufficiently to warrant the extensive use of this means by those breeders who have not made a careful study of this subject.

The Whelchel's Dent corn, originated by Mr. J. M. Whelchel, of Gainesville, Ga., is a striking example, however, of the use of crossing as a means for securing a new and improved variety of corn. In 1904 Mr. Whelchel secured 1 bushel of seed of four distinct varieties of white dent corn and mixed the seed of these four strains of corn together before planting. He planted the mixed seed in a 50-acre field isolated from all other corn. In 1905 he selected a new type which he found among the plants grown from the crossed seed. This new type came comparatively true to seed in 1906 and again in 1907. It possesses certain characters different from any of the parent varieties, is a very high-yielding variety, and is more profitable than any of the parent varieties in the regions to which it is adapted for growing.

BREEDING RESISTANT VARIETIES.

The wilt-resistant varieties of cotton and cowpeas, the nematode-resistant variety of tobacco (Pl. XX, fig. 1), and other resistant varieties of crops have made possible the more profitable growing of the crops in the sections where they are subject to the attack of fungous diseases and to insect injury. Owing to the increasing loss to growers from these causes, the production of resistant or immune varieties of crops where needed is one of the most important fields of work for the breeder.

THE BREEDER.

CHARACTER, QUALIFICATIONS, AND METHODS OF WORK.

Success in the improvement of farm crops depends to a great extent on some important qualifications of the breeder. The breeder must

FIG. 1.—FOUR PLANTS OF CONNECTICUT BROADLEAF TOBACCO, SHOWING LACK OF UNIFORMITY OF TYPE RESULTING FROM NEGLECT OF SEED SELECTION.

FIG. 2.—TWO ROWS OF UNCLE SAM SUMATRA TOBACCO GROWN IN CONNECTICUT, SHOWING UNIFORMITY OF TYPE CHARACTERS SECURED BY SEED SELECTION.

FIG. 1.—RESISTANT TOBACCO PLANTS, SHOWING REMARKABLE GROWTH ATTAINED ON INFESTED SOIL IN FLORIDA, WITH TWO PLANTS WHICH HAVE SUCCUMBED TO ATTACKS OF NEMATODES IN FOREGROUND.

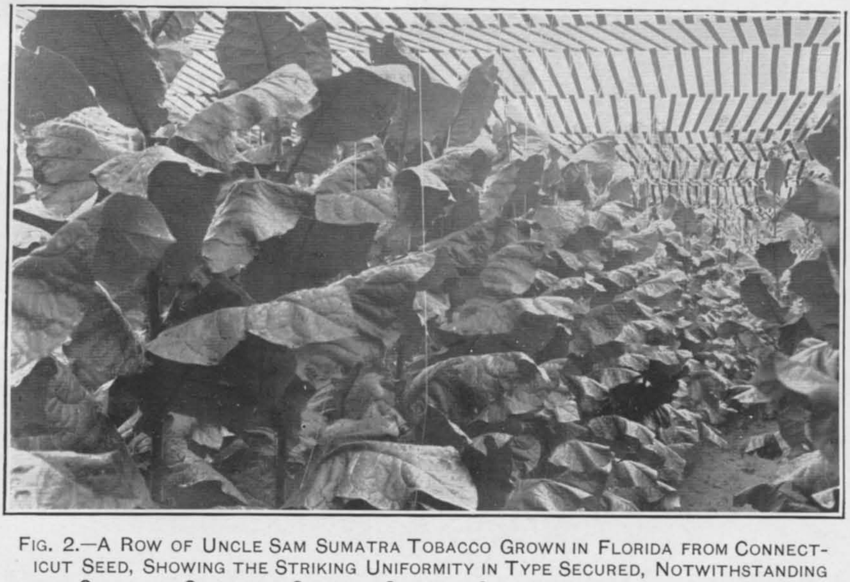

FIG. 2.—A ROW OF UNCLE SAM SUMATRA TOBACCO GROWN IN FLORIDA FROM CONNECTICUT SEED, SHOWING THE STRIKING UNIFORMITY IN TYPE SECURED, NOTWITHSTANDING THE COMPLETE CHANGE IN SOIL AND CLIMATIC CONDITIONS.

FIG. 1.—TWIN EARS OF CORN, AN UNUSUAL MUTATION, SHOWING WIDE RANGE OF VARIABILITY IN MANNER OF GROWTH AND AFFORDING AN EXCEPTIONAL OPPORTUNITY FOR THE PRODUCTION OF NEW TYPES.

FIG. 2.—TEN EARS OF REID'S YELLOW DENT CORN, SHOWING THE RESULT OF FIFTY YEARS OF CONTINUED SELECTION OF SEED IN THE DEVELOPMENT OF UNIFORMITY IN THE SIZE AND SHAPE OF EARS AND KERNELS, THE FILLING OUT OF TIPS AND BUTTS, THE REGULARITY OF INDENTATION, AND THE DESIRED EVENNESS IN THE ROWS OF KERNELS.

have a natural liking for his work and the plants with which he carries on the work of breeding. The experience gained by constant association with the crops upon which the breeder works is the most important factor involved in the production of new or improved varieties. It is this experience that makes it possible for the breeder to pick out the best plants almost intuitively, although in many cases it is not possible to give exact reasons for the selections. This accurate judgment comes easiest to those naturally adapted for this work, but it may be developed in any careful person who has a real interest in the subject by the study of the plants from all possible sources of knowledge.

The importance of this natural adaptation to the breeder's work is shown by the fact that most of our valuable varieties of farm crops have been produced by men possessing this characteristic in the highest degree. The history of some of our most valuable varieties is the best possible illustration of the methods of breeding employed and of the qualifications of breeders most likely to succeed in efforts of this character.

The Reid's Yellow Dent variety of corn was originated by Mr. James L. Reid, at Delevan, Tazewell County, Ill. Mr. Reid was one of the pioneer settlers of Illinois who raised a comparatively small acreage of corn, doing most of the work with his own hands, but was a successful corn grower. He spent much of his time in the study of the crop and the selection of the seed. The result was that he produced a variety of corn (Pl. XXI, fig. 2) that has been found to yield more money value to the acre under the conditions to which it is adapted than the unselected varieties. This fact has led to its wide distribution; and because it has made corn growing more profitable than heretofore, it has been an object lesson that has served to inspire further efforts along this line by many other corn growers. Its history can not be presented better than in Mr. Reid's own words to the writer:

In 1846, when my father, Robert Reid, moved from Ohio to Delevan Prairie, he brought, with other goods, his seed corn. This corn was known in Brown County, Ohio, as the Gordon Hopkins corn. It was not a yellow corn, but reddish or flesh colored, which gave to the shelled corn the appearance of being highly mixed.

It was quite late in the spring of 1846 when my father arrived in Delevan. Uncle Daniel Reid, who had settled here some years previous, had the ground prepared for corn and the field was at once planted. The crop was good but imperfectly ripened. The best of it was selected for next year's seed, but being immature the stand of corn for the crop of 1847 was very poor and had to be replanted. This was done by putting in the missing hills with a hoe and using for that purpose a small corn that was grown in the neighborhood at the time, known as the Little Yellow corn. I am unable to give anything of the history of this variety; but what I call Reid's Yellow Dent has been bred from the

result of that cross, by selection, to what it is to-day—an almost pure yellow corn of medium size and medium early in maturing. The ears carry their size fairly well, have a solid deep kernel that grows very compact on the cob, and will shell about 86 per cent of grain after it is thoroughly dry.

It has always been my plan to select my seed at husking time, as then a better selection of ears can be made than could be done previously. In caring for the seed during the winter I find that the important thing is to have the seed dry in the fall, then keep it dry during the winter, and there will be no cause for complaint of a poor stand of corn at planting time.

A study of the history of many other important varieties of dent corn, such as the Boone County White, Leaming, and Silvermine; of varieties of sweet corn, such as Crosby, Evergreen, and Country Gentleman, and the valuable and widely grown varieties of all classes of corn shows that the originators were men, like Mr. Reid, who were practical corn growers, having a natural ability for breeding work, and their judgment, gained by long experience with the plants, enabled them to pick out, year after year, the ideal type of seed ears.

The history of Triumph cotton, a short-staple variety, is a typical illustration of the origin of most of the valuable varieties of the cotton crop, the plants of which are only partially subject to cross-fertilization. This variety was originated by Mr. A. D. Mebane, of Lockport, Tex., in 1899. Mr. Mebane, a cotton grower of this region, when the boll weevil threatened the successful growing of cotton on his farm about 1898, tested several of the then earliest varieties, among which were the Boykin Stormproof and Peterkin varieties, in order to get earlier maturing crops to avoid so far as possible injury by the weevil.

In the field of the Boykin Stormproof grown in 1898, Mr. Mebane found a plant that he thought was the best plant he had ever observed, especially with respect to the character of the lint. He saved the seed from this plant separately from the rest of the seed, delinted the seed by hand, and planted it the following season (1899) in a separate row across the field. The yield and quality of cotton produced in this row were so superior that the grower decided to call the type Triumph and propagate the seed for distribution. The seed from this row was planted in a separate field in 1900, and produced such a valuable crop, adapted to the conditions where it was grown, and came so true to the type of the original parent plant that the value of this variety was recognized by many cotton growers. The seed of the variety became widely distributed and has justified the hope of the originator that it would become an established and profitable variety of cotton. The history of this variety points conclusively to the fact that the success of the breeders of cotton has been measured by their ability to find new and valuable plants.

The White Burley variety of tobacco was originated by Mr. George Webb, of Brown County, Ohio. Mr. Webb found in his field of

tobacco (probably the old Red Burley variety), in the season of 1864, a few plants strikingly different from the prevailing type of the plants in his crop. These plants possessed the peculiar habits of growth, color, texture, and shape of leaves that distinguish the White Burley tobacco. The seed of these plants was saved separately, and plants grown from the seed were set out in a field separate from the rest of the crop the following season. The improved quality, as well as the increased yield of this field, was so marked that it attracted the attention of tobacco manufacturers and growers alike over the entire district adapted for growing this kind of tobacco. Seed of this type, called White Burley, was secured by growers in Ohio, Kentucky, and Tennessee, and as its value was demonstrated by trial the variety rapidly spread until at present it is one of the most extensively grown tobaccos for the purposes of smoking and plug manufacture. The origin of this variety is a further illustration of the fact that favorable conditions for breeding new types of tobacco are frequently not the most favorable for the production of the crop. The growing of the White Burley tobacco is a limited industry in southern Ohio, while it is grown most extensively and successfully in Kentucky.

LIMITATIONS OF EFFORT.

Nearly all of our most useful varieties of farm crops have been originated by breeders who have concentrated their time and energy and ability on but one variety, or at most but few varieties. This is particularly true of the varieties of corn, cotton, and other cross-fertilized or partly cross-fertilized crops. In these crops, after the type of plant desired is found, it is necessary to fix the type by long-continued selection. To make these selections requires so much time and effort that it is not possible for the breeder to work for the improvement of many varieties at the same time. In the case of self-fertilized plants, like wheat, oats, and most of the legumes, after the ideal plants have been found the further improvement of the varieties developed from these parent plants is more simple than in the case of the cross-fertilized plants. However, even with inbred plants few instances have occurred where breeders have achieved the highest success with more than one or two crops.

NECESSITY FOR CONTINUED EFFORT.

The discovery of mutations, or sports, and desirable plants for propagation may be made at any time by the trained breeder. An illustration of a striking mutation in corn is shown in Plate XXI, figure 1. Unfavorable conditions of season for the growth of the crop may be most favorable for finding the best plant for breeding purposes. The propagation of the seed borne by these plants and their

testing under different conditions in order to determine their comparative value for commercial production frequently require years of untiring and painstaking effort. It was more than a quarter of a century after the Reid's Yellow Dent, the Boone County White, or the Leaming varieties of corn were developed by the breeders that these varieties began to come into general use in those sections of the corn belt to which they are adapted.

The same long-continued effort has been necessary in the case of most of the valuable varieties of crops now in use. The increase of knowledge of breeding, due to the work of the scientific investigators in this field, has enabled the breeders to achieve results more quickly than heretofore. Notwithstanding these short cuts, the fact still remains that really valuable varieties have been developed and come into general use gradually and only after years of patient work. It is fortunate that such is the case, because in this way mistakes have been avoided from the use of varieties that do not hold up to the standard or are not adapted to the local conditions where they are planted. The work of the breeder becomes more valuable in proportion to the length of time spent in the improvement of the varieties.

THE IMPORTANCE OF EXPERT KNOWLEDGE OF PLANTS.

The value of the selections of desirable plants for propagation depends on the judgment of the breeder, founded on a natural ability to do such work and developed by experience.

The score card is a valuable means for studying or teaching the work of corn judging. It assists the student or investigator in making careful and exact comparisons of some of the characters of seed corn. It is not the most efficient means of judging corn, however, and the real judge whose work is efficient and lasting does not need to use a score card as a means for selecting the best samples of corn; in fact, it interferes with his work. In many cases the best judges of corn are unable to give in detail the reasons for their decisions, as is frequently the case with breeders whose work has been of the greatest and most lasting value.

The expert knowledge gained by constant study of plants under all conditions enables the breeder to select the best individuals without elaborate analyses, detailed examination, or exact tests. It enables the corn breeder to pick out the best ear of corn at the moment of handling it, the cotton breeder to see the best plant in the field under observation, or the tobacco breeder to select the best plants in the field or the best sample of cured leaves in the warehouse on inspection. The student may train his judgment by the use of score cards, experimental tests, and a study of the results of scientific investigation, but the really important factor of all breeding is the development of expert judgment necessary for the practical breeding and seed selection.

THE PROPAGATION AND DISTRIBUTION OF NEW AND IMPROVED VARIETIES.

The difficulty in securing reliable and pure seed of the variety of crop desired has been the chief barrier in the way of the more extensive use of improved seed by farmers. This is especially true with regard to varieties of corn, cotton, tobacco, and other general farm crops subject to cross-fertilization. The production of seed crops free from cross-fertilization with other varieties necessitates the growing of these crops in isolated fields or protecting the fields in some manner from the pollen of other varieties grown in adjoining fields. In addition to cross-pollination from different varieties the seed ears should be protected from pollination by inferior plants in the same field. This can be done by detasseling the inferior corn plants before the pollen falls, pulling out the inferior plants before they bloom in the seed-cotton fields, and covering the seed heads of tobaccco seed plants with light but strong paper bags before the blossoms open. In the case of wheat, oats, rye, and other self-fertilized crops there is no danger of crossing, but there is danger in mixing the improved seed with other or inferior seed in thrashing or handling the crops. Cotton seed is usually taken by the grower direct from the gin, and may contain a considerable amount of seed left over from previous ginnings of other varieties. The breeder and distributer of improved seed must adopt the best precautions available, such as the use of seed separators and cleaners, so that the seed sent to growers will be unmixed and true to type.

It is not probable that all corn growers, for example, can arrange to grow seed free from crossing with neighboring varieties or that all cotton growers can protect their seed fields fully from other varieties, and in this fact lies the commercial opportunity of the seed breeder. The supplying of uniform and pure seed to the growers who do not have the opportunity or conditions for keeping their varieties free from crossing and who must of necessity go to the breeder for fresh seed frequently is the most important and profitable field for the work of the breeder.

ORGANIZED EFFORT.

The importance of breeders' associations for promoting the work of live-stock breeders has been demonstrated by their associations. The organization of plant breeders along the same lines has just begun, but results indicate that their work will have an important bearing on the future of the industry.

In 1900 the writer suggested the organization of the corn breeders of Illinois, which was carried out and a permanent organization effected, called the Illinois Corn Breeders' Association.[a] The object

[a] Bulletin 63, Illinois Agricultural Experiment Station. "Seed Corn and Standard Varieties," by A. D. Shamel.

of this association is to encourage the growing of improved breeds of corn, the adoption of improved methods of corn breeding, and to provide that the members of the organization sell only such seed corn as meets the standard set by the organization. The most important step was taken when it was agreed that seed corn must be sent to the producer on the ear, thus enabling the grower to judge more definitely than heretofore of the character and value of the seed purchased. Varietal standards were adopted, so that corn growers buying the seed corn from the breeders could more nearly judge of the adaptability of these varieties to their conditions. Provision was made for a careful test of all seed corn sold, so that only seed of strong vitality could be distributed.

This organization had the effect of stimulating the breeding of improved varieties of corn in Illinois, of establishing confidence in the minds of corn growers in the quality and value of the improved varieties, and of encouraging the use of improved seed over the entire State. Similar organizations have now been effected in all of the leading corn-growing States, and there is no doubt of the value of the work of these organizations both to the corn breeders and the corn growers, as shown by the increase in yield in these States. The organizations of active breeders' associations of this character for all the leading crops would be one of the most important steps in the work of improving the existing varieties of these crops and would encourage efforts for the production of new and valuable varieties.

SUMMARY.

The writer has attempted to point out that there are at least two distinct lines of work in the improvement of crops by breeding and seed selection: (1) the art of breeding and (2) the science of breeding. The results of scientific investigation are of great importance to the breeder, but the methods of scientific investigation are not always applicable as methods of breeding. The great field for the breeder's art lies in the improvement of existing varieties of crops and their adaptation to local conditions of soil and climate. Another but less important work is the production of new varieties adapted to new agricultural conditions. The breeder should have a natural adaptability for his work, and the value of his work will depend largely on his expert knowledge of the varieties of crops to which he directs his efforts. The work of breeding and the results, at least so far as the distribution of the seed is concerned, can be most effectively done by organized effort.

THE VALUE OF INSECT PARASITISM TO THE AMERICAN FARMER.

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INTRODUCTION.

The term "farmer," as here applied, is intended to include only those husbandmen who are more or less extensively engaged in the cultivation of cereal and forage crops, whether in connection with stock raising or otherwise. According to Volume V, Report of United States Census for 1900, there were on June 1 of that year in the United States, exclusive of Alaska and insular possessions, 1,319,854 farms from which the principal source of income was hay and grain and 1,564,215 farms from which the principal source of income was live stock. These farms are occupied, owned, or managed by the class of people here designated as the American farmer, and it is for the benefit of such that this article has been prepared. It is in fact a sequel to the one prepared by the same author for the Yearbook for 1905, wherein the farmer was shown how he might, in many instances, protect himself from the ravages of some of the insect pests of his crops by incorporating into his cultural methods certain practical measures likely to ward off attacks from some of these destructive insects. The object of the present article is to show him that not all insects are destructive, but many are beneficial; to indicate some of the ways whereby nature, through these beneficial insects, is exercising a perpetual restraining influence over many destructive pests, and to point out possibilities for his taking advantage of and utilizing these obscure forces in nature—the parasitic insects—in preventing disastrous outbreaks of destructive insects, and in this way reducing financial losses in the future.

Many, possibly the majority, of these farmers have read in the public press more or less accurate statements of the benefits that have been derived by the fruit grower, perhaps thousands of miles away, from the good offices of some beneficial insect or insects, perhaps artificially introduced; but only to an infinitely small number of these people will it ever occur that perhaps even greater and more valuable services are, wholly without their knowledge, being constantly rendered to themselves in their own communities and on their own

farms by insect parasites long well known to science. Contrast this condition among farmers with that prevailing among present-day medical practitioners and surgeons, who have long ago ceased to resort to the remedy of bleeding their patients and are more and more bending their whole intelligent efforts toward aiding nature herself in bringing about recovery. It was years after the fact was established that the Texas fever of cattle was transmitted by the cattle tick, *Margaropus annulatus* Say, that we became fully aware that malaria and the dreaded yellow fever are diffused by mosquitoes; and the world is only just now learning that the fatal "sleeping sickness" of South Africa is transmitted from the larger wild animals to human beings by the tsetse fly, *Glossina palpalis* Rob. Desv. In view of these facts, the unscientific farmer may well be pardoned for his unfamiliarity with the common though obscure parasitic enemies of the insect pests of his crops, although it is surely time he were posted on the constant beneficial influences of some of them and with the efforts that are being made to utilize their services in an economic direction.

RECENT ORIGIN OF INSECT DEPREDATION IN AMERICA.

Insect depredation in field crops in America is of comparatively recent origin, partly because, until large areas were brought under cultivation, there was little to devastate, but principally owing to the fact that, under conditions which are not disorganized by man and his influences, the relations between different organisms are so finely adjusted that very rarely does any single species become excessively abundant. With the advent of the Caucasian and the destruction of a great variety of native vegetation over large areas of country, displacing this with a few introduced plants, the whole system has been thrown out of balance, as it were, and natural selection has to some extent failed to keep pace with artificial selection. Then, too, in our reaching out over the world for the vegetable products of foreign countries we have accidentally imported a considerable number of destructive insects, some of which have been rapidly diffused after introduction, either by natural spread or through the various channels of inland trade, and, in many cases, the natural enemies or parasites of these introduced pests have not been brought to this country with them. As a consequence much financial loss has resulted, because the restraining element of parasitism has here been eliminated, at least temporarily, until native parasites have learned to prey upon them.

FLUCTUATIONS IN INSECT ATTACKS.

One of the most perplexing phases of insect depredation is found in the fact that there will be a year when some particular insect or

insects will become exceedingly abundant and commit serious ravages, and the next year will seemingly have totally disappeared. While these phenomena are sometimes due to direct effects of the weather, more often, and perhaps even usually, they are due to meteorological effects on the parasites themselves. Indeed, meteorological influences are far-reaching, and may bring about an outbreak, not because such weather conditions are particularly favorable to the depredator, but because they are decidedly unfavorable to the parasites.

LYSIPHLEBUS AND THE SPRING GRAIN-APHIS.

Perhaps the interactions of these organisms, the perpetual restraint of parasites, and the effect of weather conditions on host and parasite may be best illustrated by the spring grain-aphis, *Toxoptera graminum* Rond. (figs. 7–10), which has during the past season committed

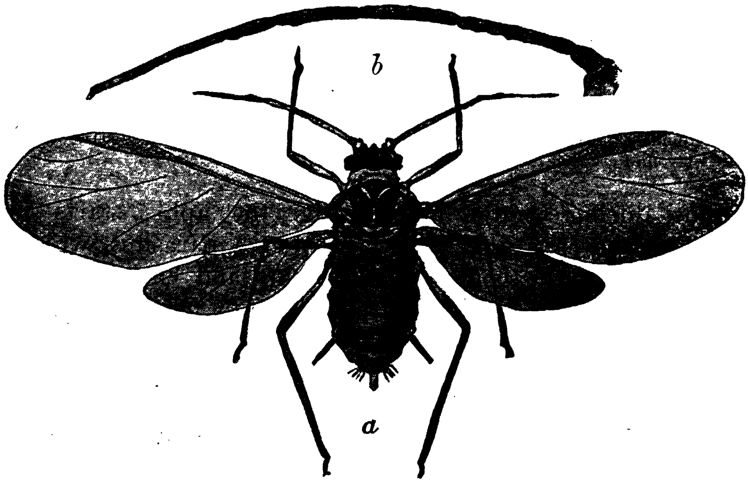

Fig. 7.—The spring grain-aphis (*Toxoptera graminum*): *a*, Winged migrant viviparous female; *b*, antenna of same. *a*, Much enlarged; *b*, highly magnified. (From Pergande.)

such depredations in the South and West. This insect is present every year in greater or less abundance and is kept under control by its natural enemies, more especially by a very tiny black and brownish four-winged fly, *Lysiphlebus tritici* Ashm.[a] (figs. 11–16). The methods of reproduction in this aphis are peculiar, there being males (fig. 10) and egg-laying females (fig. 9) in autumn. It gives birth to young from spring until fall; and it winters, normally, in the North at least, in the egg state, the eggs being deposited in the fall among both grains and grasses. But during mild

[a] *Lysiphlebus tritici* has recently been reared from the corn leaf-aphis (*Aphis maidis* Fitch) and the European grain-aphis (*Siphocoryne avenæ* Fab.) in the West.

winter weather young are born as long as such weather continues, while the parasite remains dormant. They will survive a temperature of +8° F., and begin to breed whenever it rises to 45° or 50° F. during the day, while for the parasite it must be at least 10 degrees warmer. Now, under normal weather

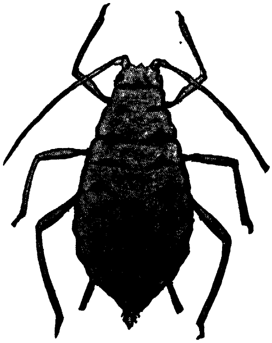

FIG. 8.—The spring grain-aphis (*Toxoptera graminum*): Wingless viviparous female. Much enlarged (from Pergande).

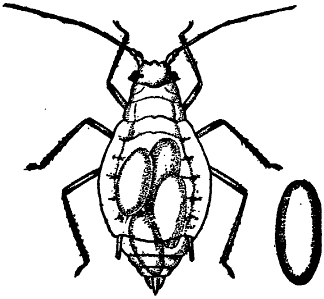

FIG. 9.—Spring grain-aphis (*Toxoptera graminum*): Egg-laying female with eggs in body, greatly enlarged; at right, egg still more enlarged. (Original.)

conditions during winter and spring, the aphis starts in the spring from the eggs, and there are enough parasites, which have wintered over in the bodies of the aphis and emerge therefrom, to destroy so many of this aphis that it can not increase rapidly

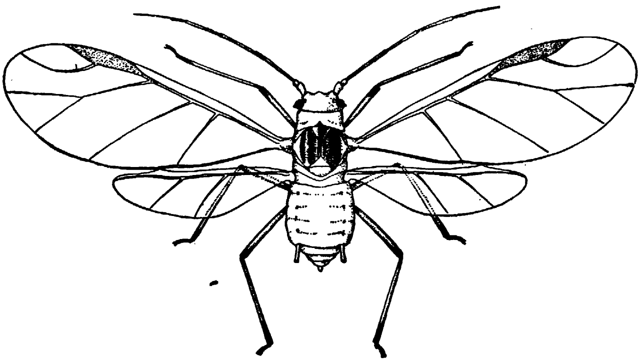

FIG. 10.—Spring grain-aphis (*Toxoptera graminum*): Male. Greatly enlarged (original).

enough to become injurious; consequently we have no trouble with it. But there comes a winter during which the temperature is warm enough to enable the aphis to breed continuously, and it thus becomes very abundant by spring. If the weather turns cold during the winter the pest ceases to breed and serious depreda-

tions are averted, but if, as is more often the case, a cold, backward spring follows an abnormally warm winter, then the pest continues to breed while its enemy remains inactive, and the result is that

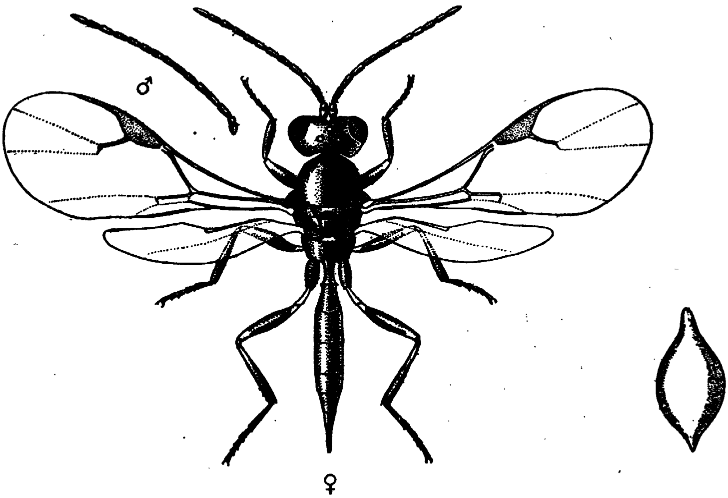

FIG. 11.—*Lysiphlebus tritici,* principal parasite of the spring grain-aphis: Adult female and antenna of male. Greatly enlarged (original). At right: Egg of *Lysiphlebus tritici.* Highly magnified (original).

the former becomes so enormously abundant that wheat and oats are destroyed over large sections of the country before the parasite can increase sufficiently to overcome it. In this connection it may be stated that under favorable weather conditions the parent aphis begins to breed by bringing forth its young on the sixth to the eighth day from its own birth, while

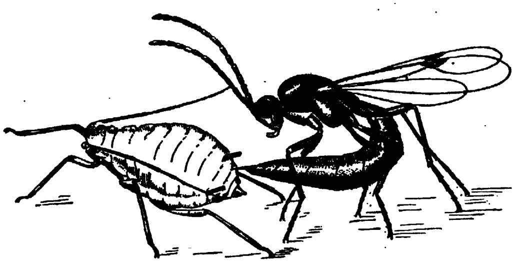

FIG. 12.—Lysiphlebus depositing its eggs in the body of a grain-aphis. Much enlarged (original).

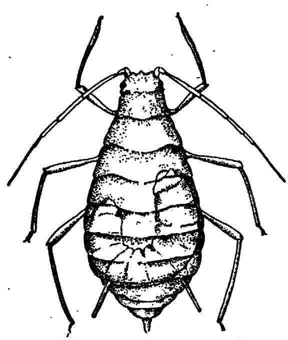

FIG. 13.—Wingless female of spring grain-aphis, containing larva of the parasite *Lysiphlebus tritici.* Much enlarged (original).

the parasite, which is not born this way, but always hatches from eggs laid in the body of its host (fig. 13), passes from egg to adult in about ten days. It is also of interest to note that, while the

aphis can give birth to from 50 to 60 young during its lifetime, the parasite is capable of depositing 400 to 500 eggs, usually only a single egg being deposited in the body of an individual aphis. Therefore the capacity for multiplication of the parasite greatly exceeds that of the host, and this advantage is very much increased by the fact that the aphis, either at once or a day or two after becoming parasitized, ceases to bring forth young. The compensating advantage possessed by the aphis is its ability to breed at a very much lower temperature.

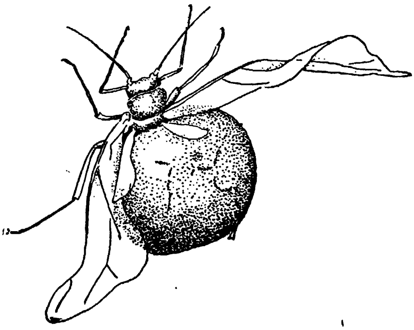

FIG. 14.—Winged female of the spring grain-aphis, parasitized by *Lysiphlebus tritici*. Enlarged (original).

The parasite, somewhat as with the host, can reproduce without males. Requiring a slightly longer time for development, it does not ordinarily cause the death of the host until after the latter has become fully developed; and if the adult aphides are winged they fly about or are transported by the winds with the young undeveloped parasites in their bodies (fig. 14), thus distributing their arch enemy wherever they may stray or be carried. They have thus become diffused from Texas and South Carolina to Canada. This is the whole secret of the destructive outbreaks of the spring grain-aphis in this country, and shows very clearly what an enormous controlling influence this parasite exerts over the pest, and it is a difficult matter to estimate the pecuniary loss to the country that is prevented by these little inconspicuous friends, which, during ordinary years, are totally unobserved and unappreciated by the farmer. In all outbreaks of this pest in this country this minute parasite unaided has finally overcome it, and while the saving to the country during that particular year is clearly almost incalculable, this saving is not to be compared with the normal saving each year consequent upon the continual restraint that the parasite exercises over the spring grain-aphis.

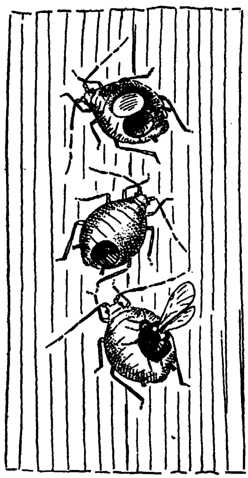

FIG. 15.—Dead spring grain-aphides, showing holes from which the matured parasites *Lysiphlebus tritici* emerge. The top figure shows the lid still attached, but pushed back; the bottom figure shows the parasite emerging. Enlarged (original).

POLYGNOTUS AND THE HESSIAN FLY.

Another apt illustration is afforded by the Hessian fly, *Mayetiola destructor* Say (figs. 17, 18, and 19), and its most minute but powerful enemy Polygnotus (figs. 20, 21, and 22). As is well known, there are two broods of this pest over the region of winter-wheat

FIG. 16.—Stalk of wheat, the leaves covered with dead spring grain-aphides killed by the parasite *Lysiphlebus tritici*. About natural size (original).

culture, one in the spring and one in the fall. In the northern part of the country the two come during summer and fall. Several instances have come under the writer's observation during the last twenty-five years which in a way indicate an important restraint constantly in force against the ravages of this pest. First

in Indiana and years afterwards in Ohio, in certain wheat fields in fall, larvæ of the Hessian fly were so abundant as apparently to destroy all prospect of the crop for the following year. Favorable autumn weather, however, enabled the plants to start young tillers after the pest had done its work, and these tillers, though they escaped attack, were so young and tender as to render it extremely doubtful whether or not they would survive the winter, and in case they did so the prospect was very good for more than a sufficient number of Hessian flies the following spring to bring about their destruction. In both cases lots of the dead young wheat plants were collected in early winter and kept indoors in a warm place. In both instances very few Hessian flies were obtained, but instead hundreds of the minute parasite *Polygnotus hiemalis* Forbes (fig. 20). The wheat pest had been almost completely exterminated in autumn by its tiny foe, and in the fields the following spring tillers grew rapidly, hardly one suffering from the spring attack, showing that there were very few Hessian flies present, and good crops were secured in both cases, whereas, but for the influence of this little parasite, there could by no possibility have been anything like a satisfactory yield. This has been the experience of almost every wheat grower, and the writer has repeatedly heard

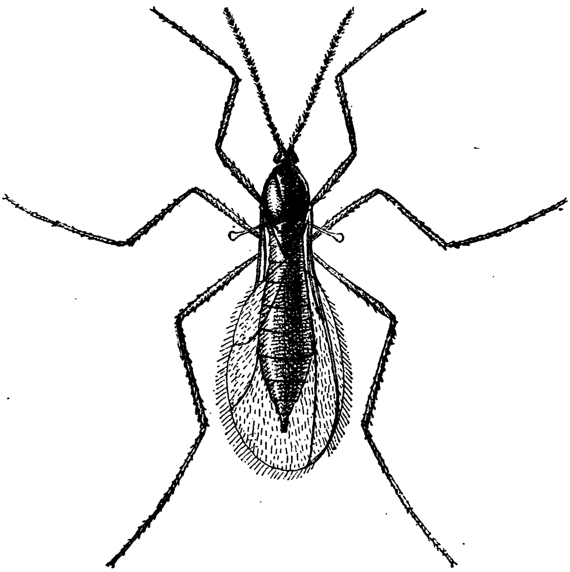

FIG. 17.—The Hessian fly (*Mayetiola destructor*): Adult female. Much enlarged (original).

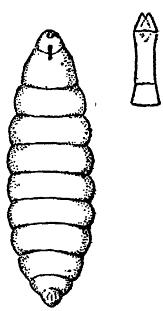

FIG. 18.—The Hessian fly: Larva taken from "flaxseed." Much enlarged, with "breast-bone" still more enlarged at right (original).

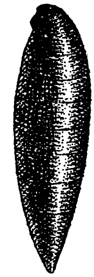

FIG. 19.—The Hessian fly: Puparium or "flaxseed." Much enlarged (original).

of similar experiences during other years, showing that the two instances cited were only two of the many that actually occurred, and indeed are occurring every year in some section or other of the country. This is most clearly illustrated by the fact that Mr. George I. Reeves, an agent of the Bureau of Entomology, engaged during the years 1905 and 1906 in investigations of the Hessian fly in the spring-wheat growing sections of the Dakotas, Nebraska, and Minnesota, became quite fully convinced that the chief element in controlling this pest in North Dakota was the continual restraining influence of minute parasites of the genus Polygnotus. In fact, from all data in hand from that section relative to this subject, including the writer's observations in 1904 just after serious injury had been done in some localities, the statement that spring wheat could not be profitably grown there but for the presence of these parasites seems entirely justified.

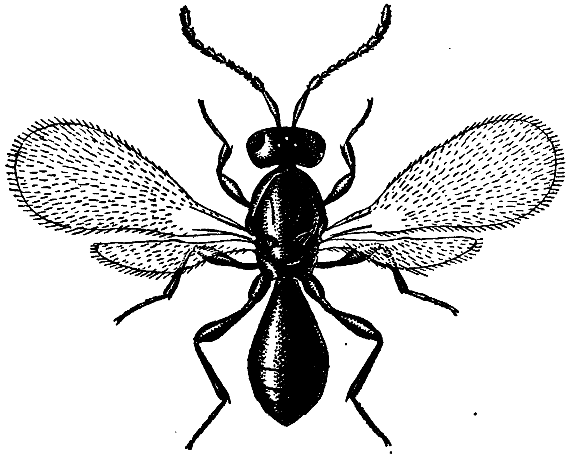

FIG. 20.—*Polygnotus hiemalis*. Much enlarged (original).

FIG. 21.—Adults of Polygnotus which have developed within the "flax-seed" of a Hessian fly (*Mayetiola destructor*) and are ready to emerge. Greatly enlarged (original).

FIG. 22.—"Flax-seed" of Hessian fly (*Mayetiola destructor*) showing two adult Polygnotus, and a hyperparasite (*Tetrastichus* sp.). Greatly enlarged (original).

The life history of this minute parasite (Polygnotus) has not been well studied in this country, but the species inhabiting Europe have been followed more closely, and from all of these studies a flood of light has been thrown on the peculiar breeding habits of these parasites and their effect on the Hessian fly. In addition, some very puzzling questions relative to the Hessian fly in America have been made more clear—all of which is to the financial interest of the wheat growers of America.

PECULIAR BREEDING HABITS OF POLYGNOTUS.

With most of the parasites that affect other insects the eggs are placed in the bodies of the host insect, and when these eggs hatch the young parasites develop within the bodies of their victims, making their escape as in the case of the spring grain-aphis and the Lysiphlebus (figs. 12, 13, and 15). But in the case of Polygnotus the breeding habit is entirely different. The eggs are placed in those of the Hessian fly (fig. 23) before the latter have hatched. This has been repeatedly witnessed here in the United States. But the fully developed parasites emerge only from the so-called "flaxseeds." It is now believed that the parasite places a single egg in each egg of the Hessian fly, and that from this single egg all of the individuals that are found in a single flaxseed (sometimes as many as 40) originate (figs. 21 and 22).

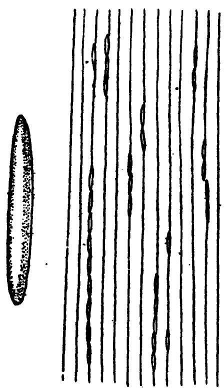

FIG. 23.—Egg of the Hessian fly, greatly enlarged; section of leaf of wheat, at right, showing eggs as usually deposited, less enlarged. (Original.)

It must be borne in mind that the effect of this parasitism is not immediate, as the parasitized larvæ attain their full growth and their destructive capacity is in no wise curtailed, but from them develop parasites and not flies. So it now becomes clear just why it is that young wheat may be greatly damaged in the fall and there be at that time every prospect of even a greater abundance of the Hessian fly the following spring, but with the advent of spring few flies appear and the grain recovers and produces a fair crop. Or, in the spring-wheat sections of the country serious ravages may occur one year and none whatever the next, with no reason apparent to the farmer for the sudden disappearance of the pest. With our present crude knowledge of the exact relations between weather conditions and these parasites of the Hessian fly it would be too much to say that with weather favorable to the Polygnotus there would be no outbreaks of this pest. Still, as one studies the problem broadly and carefully he can not fail to be impressed with the similarity between the effect of the Lysiphlebus on the spring grain-aphis and that of Polygnotus on the Hessian fly.

TACHINID FLIES AND THE ARMY WORM.

Another agricultural pest is the notorious army worm, *Heliophila unipuncta* Haw. (fig. 24), which appears at irregular intervals and depredates on farm crops, frequently doing many thousands of dollars damage to the farmer. The worms appear in countless numbers and travel together in masses in some particular direction, destroying

grain and grass crops as they go. It has been observed that this pest never occurs two years in succession in any given locality, no matter how abundant and destructive it may become during the single year of its occurrence. In the development of the insect from caterpillar to adult the former, when full fed, descends a short distance below the surface of the ground and there passes through the pupal stage, emerging later as a moth or miller. But if one will go about the fields that are being devastated he will observe that many, and, indeed, usually the majority, of these army worms have small elongated white spots on their bodies (fig. 24, *b*). These are the eggs of one or more species of tachinid flies, usually *Winthemia quadripustulata* Fab. (fig. 25). If, later, after the army worms have disappeared, he will again visit the fields he will be struck with the great number of robust flies present, and sometimes in their flying about they make a droning noise not unlike that of a swarm of bees. Also, if he will collect a quantity of these army worms and place them in a box covered with a fly screen of wire, he will find that he will rear largely flies and almost no moths at all. The writer can recall only a single instance in the many outbreaks of the army worm that he has investigated in the last thirty years where this phenomenon was not to be observed. Besides, there are cases on record where these parasitic flies have undoubtedly and perceivably frustrated disastrous outbreaks of the army worm, which, had these not been prevented, would have cost farmers hundreds of thousands, if not, indeed, millions of dollars. While this evidence may to many farmers appear somewhat fragmentary, to those who study insects carefully it will not be difficult to perceive the logical relation of the facts presented.

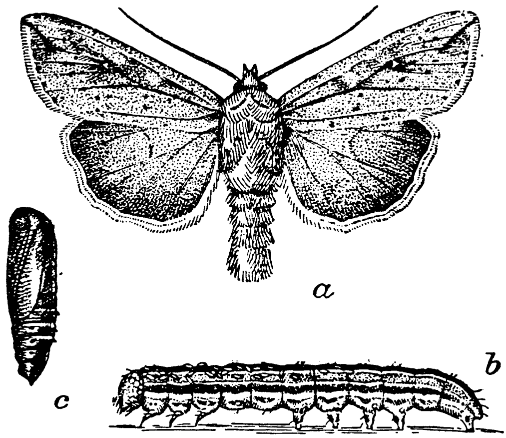

FIG. 24.—Army worm (*Heliophila unipuncta*): *a*, Adult moth or miller; *b*, larva or army worm, with eggs of tachinid parasite on back; *c*, pupa. Slightly enlarged (original).

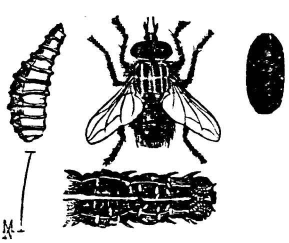

FIG. 25.—The red-tailed tachina fly (*Winthemia quadripustulata*), with its larva at left and its puparium at right; below is the forepart of the body of an army worm with tachina eggs attached. Somewhat enlarged (from Comstock).

These flies may reproduce in some other kind or kinds of caterpillars, but, during a year when the army worm is excessively abundant, the flies, finding these in such numbers, place their eggs on them, and the maggots hatching from such eggs eat directly through the skin and feed inside upon the fatty parts of their victims, without, however, destroying any of their vital parts. The final result is that, while the parasitized worms develop and do more or less damage to crops, there are few adults to perpetuate the species and the pest is so nearly exterminated by the parasitic flies that it is usually several years before they again occur in sufficient numbers to occasion any further financial losses. It should also be noted that outbreaks of this pest seldom occur during years when the weather in spring is favorable to their parasites.

PARASITIC FLIES AND GRASSHOPPERS.

Although the parasitic flies do not seem to have the same effective restraint over the abundance of grasshoppers that they do in the case of army worms, still there are many cases on record where they have destroyed great numbers of these pests. A couple of recent cases will suffice for illustrations. A correspondent at Fort Laramie, Wyo., writing under date of August 7, 1906, and sending specimens of both grasshoppers and alfalfa with his letter, says:

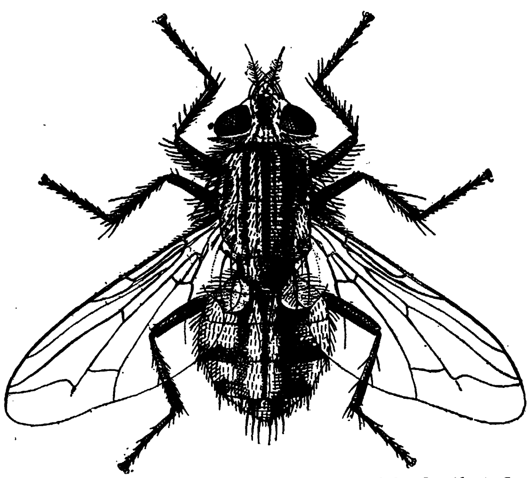

FIG. 26.—*Sarcophaga georgina*, a parasitic fly that destroys grasshoppers. Much enlarged (original).

> The specimens were cut from various places over an area of about 6 acres, more than 5 acres of which is well planted to alfalfa. The dead are most numerous along the north side of the field, but are thickly clinging to stalks over the whole area. Those on grass and weeds were taken from along the edge, just outside the alfalfa. The live "hoppers" are still very thick over the same area, but many are weak and seem in a dying condition.

In this case the pest was the differential grasshopper, *Melanoplus differentialis* Thos., and the parasitic fly was probably *Sarcophaga georgina* Wied. (fig. 26). When this material was received it was a mass of decaying grasshoppers intermixed with the maggots of this fly. This fly has been known to destroy grasshoppers in various parts of the country, notably in Georgia.

Under date of July 10, 1907, a correspondent at Coulee City, Wash., reported grasshoppers in his locality dying off by millions, and in the body of each was a worm, presumably the maggot of one of these tachinid flies. While these tachinid flies, of which there is a large number of species, more generally attack the caterpillars of butterflies and moths, including the several species of cutworms, they nevertheless infest other insects, even including active, full-grown grasshoppers.

PERPETUAL BENEFITS OF PARASITES.

The perpetual benefits of parasites may be likened to the benefits derived in our larger cities from thoroughly organized fire departments. There always have been, and presumably always will be, occasional disastrous conflagrations in such cities, but this fact does not in the least detract from the value of this fire service in extinguishing thousands of fires in their incipiency, and thus continuously affording almost incalculable protection to both life and property; and it would be ridiculous to base the value of such services on the work of subduing a great conflagration which is perhaps the least important phase in the problem of fire control. Still, it is only in case of large conflagrations that the public really witnesses the usefulness of the firemen, while, of the thousands of cases where fires are prevented or subdued with slight losses, the public know little or nothing. The same is even more true in the case of insects. The work of parasites in keeping down the numbers and preventing destructive outbreaks of crop pests is virtually unknown and unappreciated by the farmers. It might be well also to call attention to the fact that a $10,000 fire in New York City or Chicago would probably be recorded in the public press of the following day from Maine to California, while a $100,000 loss by insect attack in some section of the country would, except perhaps locally, remain unknown.

Though the perpetual restraining influence of beneficial insects is very obscure, we have numerous proofs of its existence. If, for illustration, one will make an indiscriminate collection of insects in the fields during summer, sweeping meadows and grain fields with an ordinary insect sweep-net, he will capture many beneficial insects belonging to numerous species, more or less of which are known to be parasitic on the enemies of the grain and forage crops of the farmer. It will, however, be quite impossible for even an expert entomologist to decide, except in a general way, which of a score of insect pests they have attacked and which are being thus kept under subjection, but their very presence is conclusive proof that they have developed at the expense of some of these pests. Again, collectors of insects very much desire perfect specimens, and in order to secure these they resort to breeding, sometimes even from the egg. But what

is the result? One of the most discouraging features of this breeding is encountered in the great abundance of parasites; so much so that it is frequently impossible to get the desired material at all, as often even the eggs are parasitized. As an example, the writer has for years noted the presence of a leaf miner in the leaves of a common grass throughout the Middle West. The miner destroys the leaves and is the maggot of some species of fly, but though the attempt has been made repeatedly, with seemingly ample material, so far nothing has been secured but great numbers of parasites; the adult of this leaf miner therefore remains still unknown.

The wheat midge, *Contarinia tritici* Kirby, sometimes known as the "red weevil," which committed such ravages during the years 1850 to 1855, is present every year and often becomes so abundant as to threaten great injury to the crop, but never quite reaches this point because of its natural enemies, some of which occur over the most of the wheat-growing country. From observations covering a quarter of a century the writer is confident that if these enemies among the beneficial insects were to be swept out of existence, even temporarily, the former ravages of this wheat midge would be promptly repeated with vastly more disastrous results than before.

Such illustrations might be indefinitely multiplied were it necessary to do so.

Another set of phenomena may be observed operating over nearly or quite all of the territory east of the Mississippi River where the common red clover, *Trifolium pratense*, is grown. There is a very small midge, *Dasyneura leguminicola* Lint., closely related to the wheat midge, that lays its eggs in the buds of red clover and whose minute red maggots blast the ovaries before they are fertilized, so that no seed is produced. Indeed, the head never comes into bloom, but remains of a green color. The periods of egg laying of this insect exactly correspond with the heading of the clover, and if this heading is delayed the bloom is not affected and seed is produced. There is another insect, supposed to have been accidentally imported from Europe many years ago, the clover-leaf weevil, *Phytonomus punctatus* Fab., whose slug-like young eat off the clover plants in spring, sometimes leaving the ground as bare in May as it was in February. The roots of the plants, however, are not affected, and send up a new growth, so that the only effect is to retard both the growth and the blooming, which prevents attack by the flower midge and thus allows the clover to blossom and produce seed. The leaf weevil does not become a serious pest, because it is itself kept in restraint by a fungous disease that kills off the young in myriads whenever these become very abundant. These interrelations exist on almost every farm every year to a greater or less degree, and the clover-seed crop, which is just now of so much value to the farmer, is probably more

influenced by these factors than by anything else. Yet probably not more than one farmer in five hundred understands why he does or does not secure a crop of clover seed. In view of all of these facts and others that might be added it does not appear to be a question of how much a farmer could raise without the protection of beneficial insects, but rather whether he could raise anything if their influences were to be suddenly removed. Instead of the farmer not being benefited except in cases of extraordinary outbreaks of destructive insects, he is continually profiting by the action of one of nature's most powerful forces, that of parasitism, a force that has probably been more largely instrumental in shaping the status of animal life over the face of the globe than we can, with our present limited knowledge, comprehend. The farmer, who deals more directly with nature than anyone else, is therefore likely to receive the greatest benefit.

THE ARTIFICIAL INTRODUCTION AND DIFFUSION OF PARASITES.

With the knowledge of the natural interrelations of these organisms known as parasites, there have followed efforts, perfectly justifiable as well as eminently laudable, to utilize this element of parasitism in assisting nature in her efforts to overcome or restrain abnormal increases of other species brought about by the disorganizing influence of man. This is as legitimate as are the efforts to harness the falls of Niagara and bring its forces into economic uses by man, or the utilizing of electricity, or the improvement of fruits and grains. The efforts that are being made for the betterment of man's condition by introducing or diffusing beneficial insects may be placed side by side with those of the physicist, the electrician, the mechanical engineer, and the plant breeder. In advances along all of these lines the earliest efforts have been crude and bungling, with progress slow, often discouraging. Indeed, every step forward has been achieved by the most patient, honest, and indefatigable labor.

In case of insect investigations, at least, all unjustifiable claims of success, whether resulting from honest error or ignorance or from more culpable causes, will bring severe discredit upon those who make them. It is unfortunate that farmers do not have a better comprehension of these matters. Naturally they have a great desire to protect their crops, but they do not seem to understand that in this, as in everything else, even possibilities are limited. For this reason they frequently expect the most improbable and unreasonable results where there is no possibility of success, and sometimes they become the willing victims of those who care more for temporary notoriety than they do for the farmers' interests and who mislead them into paths that they are prone to follow, but which end only in failure to help them out of their difficulties.

It would seem at least reasonable to suppose that science might devise legitimate means to assist nature in overcoming abnormal conditions among insects by promptly introducing the insect enemies of the one to be suppressed, thereby promoting the increase of the parasite so as to secure its beneficial effects earlier than they could be secured by the usually somewhat slow methods of nature, provided always that we are sufficiently familiar with the nature of the species involved. On the other hand, it would be unfortunate for us to go to the opposite extreme, as some have recently done, of claiming that artificial repressive measures against the Hessian fly are unnecessary, since its natural enemies can be depended upon to keep it under the best condition of suppression possible. Such claims as this only have the effect of misleading the public who do not know, and illustrating a regrettable lack of information or perhaps forethought on the part of those who make them. Such a condition can not possibly exist except in a state of nature unaffected by the influences of man. If the farmer will cease sowing wheat, the Hessian fly will certainly require no artificial measures of restraint.

It is very necessary to know just what is being accomplished before definite promises of assistance to the farmer can be made. It now seems practicable to transport parasites of the Hessian fly from one point to another. As shown by the following two instances, this has twice been done within the last few years, under the writer's direction, and two other experiments are now in progress in transporting Polygnotus from Michigan and Pennsylvania to an area in southern Kansas and northern Oklahoma and to the Pacific coast with the hope of overcoming outbreaks of the Hessian fly in these sections of the country.

A species of Polygnotus was in the spring of 1905 undoubtedly introduced from North Dakota into an area lying in western Kentucky and Tennessee. But this was just following a disastrous outbreak of the Hessian fly in this area and wheat was mostly sown late in the fall of 1905, too late for the fly to deposit its eggs on the young plants, thus interpolating a measure of itself efficient in stopping the ravages of the pest. But not all of the sowing was done late enough to prevent oviposition by the pest, and the parasite was found to be abundant in that locality the following year. Now, while there was no actual unaided suppression of the Hessian fly by Polygnotus in this experiment, we know that the transportation and colonization of the parasite from the spring-wheat fields of North Dakota into the winter-wheat fields of western Kentucky and Tennessee was accomplished, although it can not be stated in dollars and cents just what the saving by this particular insect was to the wheat grower.

The same or a closely related parasite was introduced in the spring of 1907 in Hessian fly "flaxseeds" from wheat fields in southern Pennsylvania, where they were abundant, into a wheat field near Sharpsburg, Md., where after a most rigid search none of the parasites could be discovered. As a result of this experiment, where in April not a single parasitized larva of the Hessian fly was to be found, on the 8th of the following July it was with considerable difficulty that any number of the larvæ of the Hessian fly could be found that did not contain these minute parasites. Besides this they were alive and ready to emerge at the proper time in the fall, when the adult flies would be abroad depositing their eggs.

On December 24 careful search was made in this locality in the earliest sown field of wheat that could be found in the neighborhood and which was situated not over a quarter of a mile from the one in which the parasite had been introduced in April. It required two hours' careful searching in order to find 30 wheat plants infested by this pest. An examination of the larvæ of the fly infesting these plants revealed the fact that nearly all of them which had sufficiently matured to render the presence of the parasite discernible were found infested, and there is every probability that if those still immature were to reach maturity an examination would show that they also were infested by this minute parasite. The evidence here is sufficient to show that the experiment has been entirely successful.

While the Hessian fly was at no time destructively abundant about Sharpsburg in 1907 there was what might justly be termed an incipient outbreak, and there is every indication that this has been suppressed by this introduction of these minute parasites from southern Pennsylvania.

The foregoing is an outline of what has been accomplished in the way of utilizing these parasites in controlling the Hessian fly. The plan for further efforts to aid the farmer along this line is to keep close watch over the wheat-growing sections of the country where the Hessian fly is known to be destructive and, with the earliest indications of an outbreak of the pest, repeat the Sharpsburg experiment and protect the farmer's interests as far as possible, though as yet we are only on the threshold of the project.

Another and an entirely different phase of this problem of utilizing parasites in the grain fields of the farmer was encountered during the present year (1907). The spring grain-aphis, *Toxoptera graminum*, began to depredate in the grain fields of Texas as early as January. By March it was ravaging the oat and wheat fields not only of this State but of Arkansas, North Carolina, South Carolina, and Oklahoma and Indian Territory. For years entomologists have known that the chief enemy of this species, and the one that normally holds it in

check, is *Lysiphlebus tritici*, and this was also known to occur over the country wherever the pest had been found. As the grain aphis

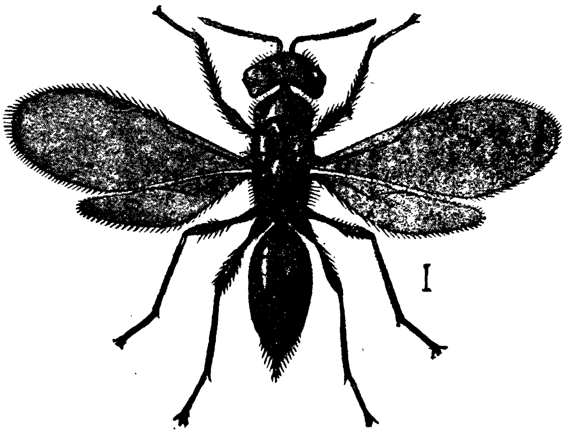

FIG. 27.—Greater wheat-straw worm (*Isosoma grande*): Adult summer form. Much enlarged (from Howard).

begins its work earliest in the South, gradually extending northward with the advance of the season, it at that time seemed practicable to collect great numbers of these parasites in these southern fields and, by throwing them into the advance of the pest, anticipate the slow work of nature by having its arch enemy on the ground in abundance in advance of the real outbreak. But the experiment was tried twice and failed in both instances. Evidently nature has a far better way of diffusing this parasite—in immature form within the bodies of its host—and the pest did not disappear earlier, more rapidly, or more completely from the fields in which Lysiphlebus had been liberated in millions than it did hundreds of miles away where no effort had been made to introduce the parasite artificially into the infested fields of grain. The parasites seem to go naturally with their host and will overcome it as soon as the temperature will permit them to breed freely. These experiments appear to show conclusively that this parasite can not be used to the advantage of the farmer in this manner. If it can be manipulated at all against this grain aphis it will have to be in some other way. Possibly assistance in controlling this

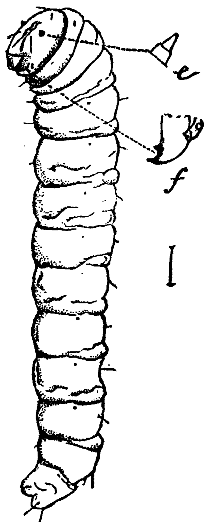

FIG. 28.—*Isosoma grande*: Larva of the wheat-straw worm; *e*, antenna; *f*, jaw. Line at right indicates natural length (after Riley).

pest will have to be afforded the grain grower in some manner other than with parasites.

During the summer of 1907 there was a serious outbreak of the wheat-straw worm, *Isosoma grande* Riley (figs. 27 and 28), or a closely related species, in eastern Washington, northeastern Oregon, and northern Idaho. This pest is common in the East every year, but does little damage. Another species apparently closely related to, or identical with, the well-known joint worm, *Isosoma tritici* Fitch, which in 1906 seriously injured wheat in Ohio, Indiana, and Michigan, has been recently found in the wheat fields about Vancouver, Wash. These outbreaks in the West appear to be entirely unrestrained by parasites, and these (figs. 29 and 30) are being sent there from eastern States. *Ditropinotus aureoviridis* Crawford was probably responsible for the disappearance of the joint-worm pest from Ohio, Indiana, and Michigan in 1907. *Eridontomerus primus* Crawford (fig. 30) has been very efficient in holding in check species of Isosoma in the East. This, too, is an experiment with a view to protecting the wheat growers of that region another year. The results, whatever they may be, will add to our knowledge of the possibility of establishing relationships among these organisms under environments differing in many respects from those obtaining in the East.

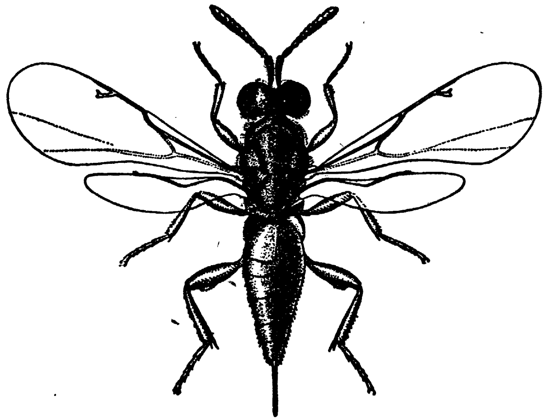

FIG. 29.—*Ditropinotus aureoviridis*, parasite on the joint worm, *Isosoma tritici*. Greatly enlarged (original).

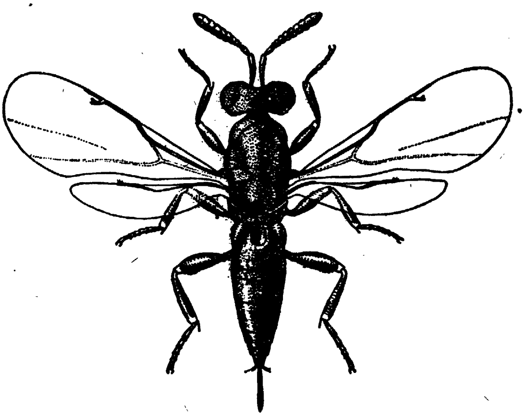

FIG. 30.—*Eridontomerus primus*, parasite on Isosoma in the Eastern States. Greatly enlarged (original).

This whole matter of artificial manipulation of parasitic enemies of insect pests affecting cereal and forage crops is an effort to aid the

farmers of the United States by keeping the whole country under a system of surveillance. When it is found that any destructive pest is rapidly increasing in one section, by the transportation and colonization of great numbers of the parasites of that particular pest from some other part of the country, where it is known to be abundant, at the proper time and under favorable conditions, it is hoped that we may be able to forestall and control, if not indeed ward off, many of these destructive outbreaks of insect pests. This is a tremendous problem, involving difficult tasks that can be followed out only by long, patient, exact, and faithful investigations, where failures and disappointments are to be expected and must be overcome.

DUST PREVENTIVES.

By Logan Waller Page,
Director of the Office of Public Roads.

PRESERVATION OF ROAD SURFACES.

The most important problem which has confronted highway engineers in recent years is the suppression of dust on roads. Not until the introduction of motor vehicles, however, did this become a factor of sufficient importance to engage the serious consideration of road builders and road users. Fast motor traffic has reached such proportions at the present time as to shorten the life of our most carefully constructed and expensive macadam roads to a great extent, and to keep them in a loose and uneven condition. Before entering into a detailed discussion of the damage to roads from automobiles and methods for its prevention, it may be well, for the sake of those unfamiliar with the subject, to consider its cause, and why the situation has become so serious of late in spite of careful study of the conditions.

The macadam road has been developed with the object in view of withstanding the wear of iron-tired horse vehicles, and it has met successfully the demands of suburban and rural traffic until the advent of the automobile. When in its highest state of perfection, the rock from which such a road is made is so suited to the volume and character of traffic which passes over it that only an amount of dust is worn off sufficient to replace that removed by wind and rain. The dust remaining should be just enough to bond the surface stones of the road thoroughly, forming a smooth, impervious shell. A road of this character wears uniformly under the traffic for which it was designed, and always presents an even surface.

When such a road is subjected to continuous automobile traffic, entirely new conditions are brought about. The powerful tractive force exerted by the driving wheels of automobiles soon disintegrates the road surface. The fine dust which ordinarily acts as a cementing agent is thrown into the air and carried off by wind or is easily washed off by rains. The pneumatic rubber tires wear off little or no dust to replace that removed by natural agencies. The result is that the stones composing the road become loose and rounded, giving the greatest resistance to traction, and water is allowed to make its way freely to the foundation of the road. (See Pl. XXII, fig. 2.)

There is another important aspect of the dust problem to be considered. Until the general use of the automobile, most of the dust formed on the road was held on the surface until worked into the gutters by the action of rain and traffic, and was not a source of annoyance, except in extremely dry and windy weather. With the coming of the automobile, however, conditions have changed, and the dust problem has become more serious. While it is true that the wear caused by the passage of heavy rubber-tired automobiles is very slight, experience has proved that they are responsible for the removal and distribution over surrounding property of the dust formed by other kinds of traffic. (See Pl. XXII, fig. 1.) The facts that dust is a spreader of disease, and that along many heavily traveled roads it has caused so much annoyance and inconvenience as actually to depreciate the value of real estate, serve to emphasize the importance of meeting this problem with the serious consideration it deserves.

Although the facts stated above may be considered in a sense as a severe arraignment of the automobile in its relation to the public road, it should not be forgotten that there is another phase of the subject worthy of serious thought. The application of mechanical arts to the comforts and conveniences of civilization must inevitably bring up new problems, which can only be solved by patient experiment. While presenting new problems, these influences generally furnish the means of solving them. In this way the automobile, while tending to destroy macadam-road surfaces, has been an important influence, not only in the building of many miles of well-constructed highways, but also in rendering most urgent the study of road preservatives. The dust nuisance existed before the advent of the automobile, and if the experimental work now being done is successful it will be a demonstration of the really beneficial effect that the automobile has had upon the development of the art of road building.

Many remedies have been suggested and tried for meeting this new condition, but a perfectly satisfactory solution of the problem is still to be found. Some success has attended the efforts of those who have sought to find a cure for the evil, and this is encouraging when the many difficulties to be overcome in the treatment of thousands of miles of roadway are considered. It is apparent that this problem can be solved only by the adoption of one or two general methods: (1) By constructing roads in such a manner and with such materials as to reduce to a minimum the formation of dust; and (2) by treating the surfaces of existing roads with materials that will give the same result.

Tar macadam and asphalt roads are good examples of the first method of construction, although the cost of these types of roads prohibits their general use for our country roads. Rock asphalt has been used in this country with considerable success, though to a very

limited extent, as a top dressing for macadam roads in place of the usual top coat of screenings, but here again the item of expense, except in localities near its source, generally prevents the use of asphalt on rural roads. In fact, the methods of construction mentioned, in so far as their general use at present is concerned, are chiefly confined to city streets. Without detracting from their value, where their use is practicable, it may safely be said that up to the present time no method of building an economical dust-proof country or suburban road has been devised. Whether it is possible for the problem to be solved eventually by following some method of construction in the first class mentioned remains to be seen, and it is by no means improbable that such a method may be found in spite of the difficulties to be met.

It is usual in treating the subject of dust preventives to classify them under a number of heads, but for some reasons it seems preferable to consider them according to the two general methods of their use on the road—those applied in their original condition, and those applied in emulsion or solution through the agency of water. It would be difficult to describe fully all of the preparations and methods of application which have been tried, and so only those of each type which have proved most successful will be considered in any detail. Many patents have been issued on special preparations, but satisfactory reports regarding their use are not available, and they will only be noticed to show the variety of substances which have been put forward as remedies for the dust evil.

Among the materials which are applied directly to the finished road surface without the agency of water, the mineral oils and coal tar are undoubtedly the most important. The value of these substances as dust preventives lies in the character and quantity of the "base" retained by the road surface after the more volatile constituents of the material have evaporated.

OILS AS DUST PREVENTIVES.

Among the mineral oils, those which contain the greatest amount of asphaltic base give the best and most lasting results, and chemical analysis will usually indicate those preferable in this respect. Some oils contain a paraffin instead of an asphaltic base, while others contain a mixture of the two. Owing to their greasy nature, paraffin oils are to be avoided as much as possible, and preference should be given to those containing asphalt, which acts as a good binder for the dust particles. The locality from which an oil is obtained is a general guide to the character of its base. Eastern oils, as a rule, contain an almost pure paraffin base; some of the Kentucky oils, and most of those found in Texas, have a mixed paraffin and asphalt base, while the California oils show an exceptionally high

amount of asphalt. In spite of the fact that California oils are far superior to the others, the cost of transportation prohibits their use in our Eastern States, where Kentucky and Texas oils must necessarily be used.

Oil for dust laying may either be applied in the crude state or be first subjected to fractional distillation at the refineries, where the lighter and more valuable products, used for illuminating and lubricating, are removed for use in the arts. An oil thus treated is called a reduced or residual oil, according to the point to which distillation has been carried. It is usually heavier and much more viscous than when in the crude state, and contains a greater proportion of the so-called "base." For this reason its use is in many cases considered preferable to that of the crude oil, although its high viscosity greatly increases the difficulty and consequently the cost of applying it to roads.

Oil has been used with some success, not only on macadam, but also on earth and gravel roads, and in this respect has its advantages over coal tar, which has so far given good results for the most part on macadam roads only. Many of the crude oils may be applied directly to the road surface by means of an ordinary sprinkling wagon, but when the oil is too heavy to be used in this way it may be applied with a suitable spraying device by the use of heat and pressure, or it may be run upon the road surface through a hose connected with the container. In some instances the oil has been applied directly to the road surface without previously removing the dust; in others, the road has been first swept clean of dust in order to allow the oil to penetrate as far as possible into the body of the road. When the latter method is followed the surplus oil which remains on the surface is usually covered with a light coat of gravel, sand, or rock screenings, and sometimes the dust which has been removed by sweeping is replaced. When a soft road is treated with oil the road is often harrowed to the depth of several inches and the oil is worked into the broken surface, which is then compacted by means of a roller. There are several patented oil spreaders which also work the oil into the surface of the road. A tamping roller has been used extensively in some of our Western States and has produced a very firm and even surface when used upon roads treated with California oil. This tamping roller not only compresses and packs the road, but also thoroughly mixes the oil with the earth. After the process of oiling and tamping has been completed, the surface is finished with an ordinary roller. (See Pl. XXIII, fig. 1.)

A number of experiments have been made in France and Algiers with petroleum, shale oil, and vegetable oils as dust preventives with satisfactory results, and similar results have, with a few exceptions, been obtained in this country. As a general criticism, however, it

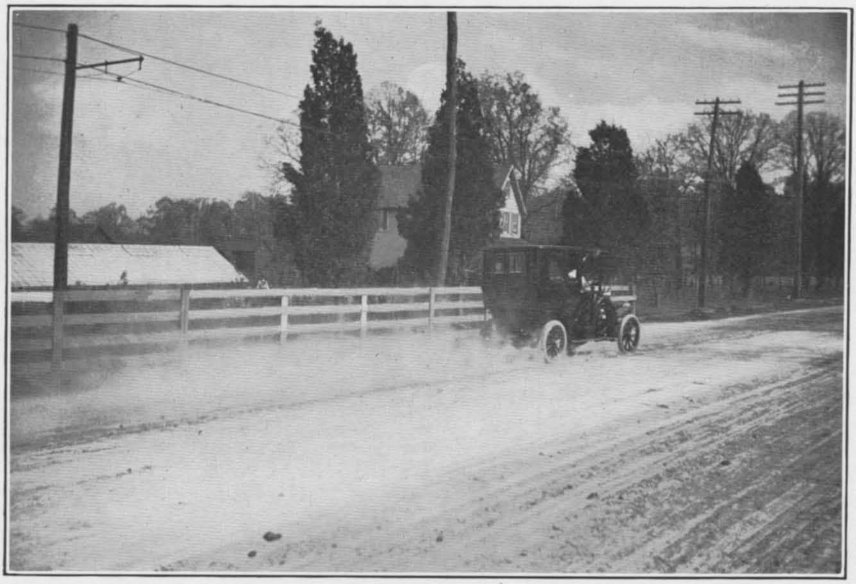

FIG. 1.—DUST RAISED BY AUTOMOBILE TRAVELING AT HIGH SPEED.

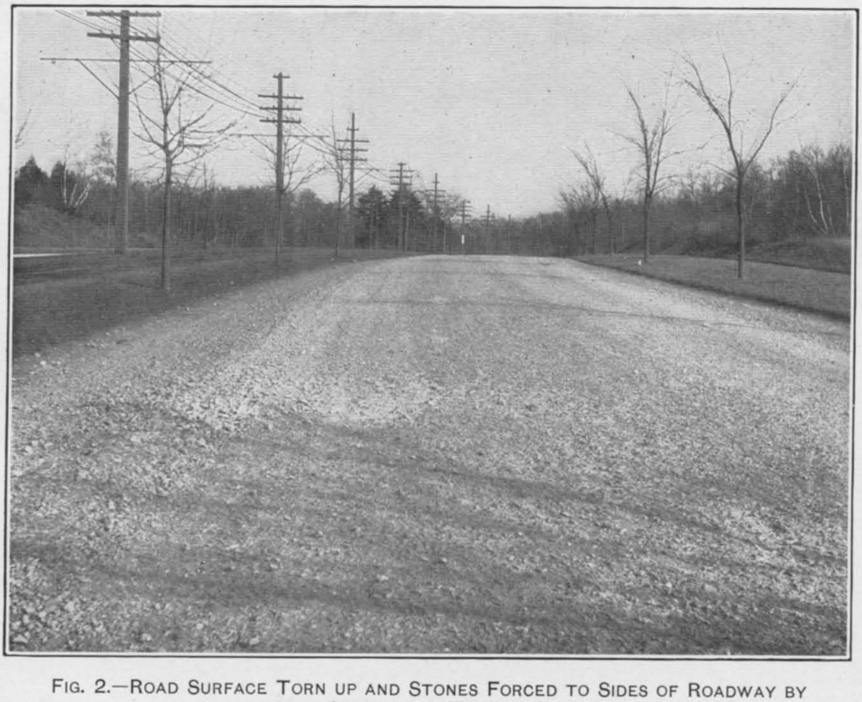

FIG. 2.—ROAD SURFACE TORN UP AND STONES FORCED TO SIDES OF ROADWAY BY AUTOMOBILE TRAFFIC.

FIG. 1.—MACADAM ROAD TREATED WITH CRUDE OIL.

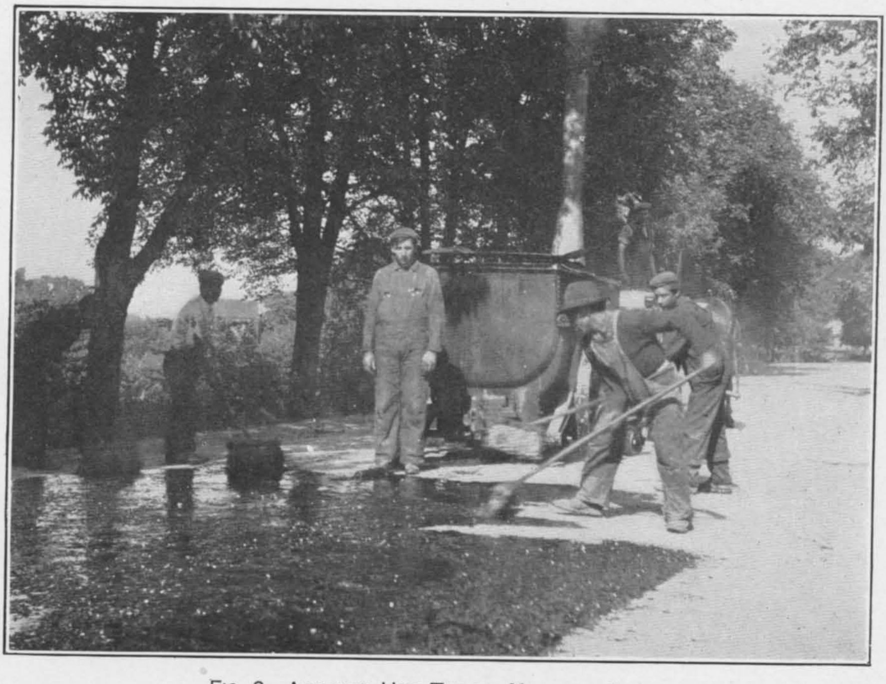

FIG. 2.—APPLYING HOT TAR TO MACADAM ROAD.

may be said that the good effects of oils as dust preventives are not usually of a lasting character. They often entirely disappear during the winter season following their use, except where sufficient quantities of a highly asphaltic oil have been used. Then, too, in rainy weather they frequently form a greasy and disagreeable mud, which is easily tracked and is damaging to clothes, varnish on carriages, and probably to rubber tires.

COAL TAR AS A DUST PREVENTIVE.

Coal tar is claimed by many engineers to be the most satisfactory material for the prevention of dust which has yet been tried. While excellent results have been obtained in many cases from the use of tar, the difficulty, and in fact the impossibility, of obtaining a uniform quality of material from different producers has led to contrary results. There are also certain general objections to its use which have been frequently overlooked by its advocates and which render it far from being an ideal dust preventive. In spite of these facts, however, the claim that for general application it has given better and cheaper results for macadam roads than any other known dust layer is not without some justification.

Coal tar is a black viscid liquid obtained as a by-product from the destructive distillation of coal in the manufacture of illuminating gas and coke. Its value as a dust preventive, as in the case of oil, lies in the character and quantity of base retained by the road surface after the more volatile constituents have evaporated. This base, called coal-tar pitch, corresponds to the asphalt base contained in oils. The crude coal tar as it comes from the gas works is composed of a number of organic compounds whose composition and relative proportion vary with the coal used and the method of manufacture. The difficulty of obtaining a uniform product is thus clearly apparent. Besides the liquid organic compounds which hold the pitch and other solid bodies in solution, the crude coal tar contains a certain amount of water and ammoniacal liquor.

Coal tar has been used with success only on hard roads from which the dust has been carefully swept. If this dust is not removed before the tar is applied, the road surface will not absorb it, and upon drying the tar will pick up and peel off very rapidly under the action of traffic. The tar is applied in practically the same manner as oil, and a great many experiments have been made both with the crude and refined products. The latter are formed by the partial distillation of the crude material, which removes the more volatile constituents and raises the percentage of pitch. The refined tars have for the most part given the best results, but as they are considerably more expensive than the crude product it is still an open question which is the more economical to use.

It has been suggested that the presence of even a small amount of water in the tar is a serious objection to its use, owing to the fact that the road surface absorbs the water more readily than the other constituents and prevents a proper binding of the road metal. It is a well-known fact that tar can not be satisfactorily applied to a wet or even damp road surface, and if water contained in the tar is first absorbed in the surface material there can be no doubt that the tar will not properly penetrate the road. Another objection to the presence of water in coal tar is that "foaming" is caused when the tar is heated to its boiling point; and where it is necessary to apply the tar hot great care is required to prevent it from boiling over the sides of the heating kettle and igniting. Tar once ignited in this way is very apt to be consumed before the fire can be extinguished.

Attempts have been made to use tar cold as it comes from the gas works, but in general the results have been unsatisfactory, except in cases where it is unusually fluid. In order to make either the crude or the refined tar flow easily, it is usually heated in large iron kettles equipped with portable fire boxes and mounted on wheels. (See Pl. XXIII, fig. 2.) The tar is drawn off through a large rubber or iron pipe and spread over the road with stiff brooms such as are commonly used for street sweeping. Sometimes instead of spreading the tar directly from the kettle it is drawn off into a kind of watering pot, the nose of which is flattened into a fan shape with a single narrow slit at the end. If a number of these pots are used the tar can be spread evenly and quickly by a few laborers, and when applied in this manner the work of spreading with brooms is greatly lessened. After the tar has been spread, it should be allowed to dry for a few days before traffic is permitted on the road. The drying process may be hastened by spreading a light course of sand or rock screenings over the surface to prevent the tar from sticking to the wheels of vehicles. The tar should be applied in warm, dry weather, and when the road is finished and opened to traffic for a few weeks it should produce much the same appearance as an asphalt street. If a heavy top course of sand or stone screenings has been applied, the road should be finished with a steam roller.

As the spreading of tar by hand is at best a slow process, there have been many machines devised to hasten the work. Trials of these machines were made during the summer of 1906 in England by a representative committee of engineers, and prizes were given to those which best met the conditions under which the trials took place. Some of these machines were designed to carry on the entire operation of tarring at one time, including sweeping the road, sucking up the dust, heating and applying the tar in the form of a fine spray, brushing it into the road surface, and finally respreading the dust over the tarred surface. None of these machines has as yet come into general

use, but it is to be hoped that some satisfactory and practical method of this kind may be devised which will reduce the cost of treating road surfaces, not only with tar, but with any similar dust-laying material.

The objections which have been advanced against the use of tar as a dust preventive are that it lasts only a short time, usually not being effective more than one season; that it produces a slippery and disagreeable surface; and that in reality it does not prevent the formation of dust, but under the action of traffic produces an undesirable though almost invisible dust. The first objection is undoubtedly well founded, for it is true that good results from its use are not lasting, the cold rains and frosts of winter usually disintegrating it. Opposed to this objection, however, stands the fact that no other substance has yet been used which for the same cost and under the same conditions will give better or more lasting results from one application. If a macadam road is properly treated and maintained with a good grade of tar there is little doubt that economy in maintenance will result if the road is subjected to excessive automobile traffic. A road properly treated and maintained by this method is practically waterproof, and any dust formed on its surface is frequently washed off by rain. It is only when the tar is breaking up and disintegrating that enough dust is formed to be objectionable.

The Office of Public Roads has at present under observation a number of experiments, which have been carried on under its direction, with various oils and tars with a view to determining, if possible, their relative merits under different conditions. This work has been conducted in the States of Massachusetts, Kentucky, and Tennessee, and it is hoped will be productive of valuable information. Trials have been made of various crude and residual oils and special oil preparations. Crude coal tar, water-gas tar, and specially prepared tars have also been used, as well as various tar mixtures. Some of the materials have been applied both hot and cold, and different kinds of top dressings—sand, gravel, and stone screenings—have been tried to see which will give the best results. Owing to the increasing number of dust preventives which are being put on the market, work of this kind is of the utmost importance, as it serves to classify the properties and uses of the different materials. By publishing the results of experiments, a repetition of many mistakes which are likely to be made in work of this nature may be prevented.

SOLUTIONS AND EMULSIONS USED AS DUST PREVENTIVES.

There are a number of preparations in the second class of dust preventives (those which are applied in solution or emulsion through the agency of water) which are claimed to give satisfactory results. As practically all of these materials have to be applied a number of times

during a season, their use is necessarily limited to those localities where water is constantly available. (See Pl. XXIV, fig. 1.)

Before the introduction of automobiles, the laying of dust by water sprinkling was in the main satisfactory. Since their presence on our roads is becoming general it has been found that in certain much traveled districts it is impossible to keep the dust down on macadam and other roads, even when water is applied as often as three times a day. Since water alone evaporates rapidly when applied to a hot, dry road, one of the first questions which presented itself was whether or not it would be possible through the agency of certain chemicals to retain the moisture for a greater length of time. A number of chemical salts have the property of absorbing and retaining moisture from the air, and as it was known that one of these—magnesium chloride—exists to some extent in sea water, it was thought that for places favorably situated the use of sea water might solve the difficulty. Many experiments have shown, however, that this water, while perhaps reducing the number of necessary applications, is not satisfactory. As magnesium chloride constitutes only a small proportion of the salts contained in sea water, the road surface has to be so completely saturated before any appreciable results can be obtained that it often becomes unsightly. The mud resulting from its use is damaging to clothes and vehicles, and when dust is formed it is found to be extremely irritating to the eyes and throat. To overcome these objections, the use of the mother liquor obtained from sea-water evaporations has been suggested and even patented. This mother liquor contains a greater percentage of magnesium chloride, and is undoubtedly to be preferred to sea water, but its application is of course limited to a very few localities.

In the manufacture of soda by the Solvay process a by-product is obtained in considerable quantities which is comparatively pure and much more hygroscopic than magnesium chloride. This product is known to chemists as calcium chloride and has so great an affinity for water as often to dissolve completely in the moisture which it absorbs from the atmosphere. As it is a fairly cheap material and one easily handled, its use as a dust layer has been tried in a number of places with more or less success. Application of the solid salt to the road has prevented the formation of dust for a short while, but as the first heavy rain is apt to remove it completely, this method has proved far too expensive. Better and cheaper results have followed its use in comparatively dilute solutions. These solutions are applied by a sprinkler in the same manner as water, at intervals varying from one to two weeks, according to the traffic, weather conditions, and strength of solution. In humid weather one application will lay the dust for a considerable length of time, provided there is no heavy rainfall, while in hot, dry weather it is necessary to moisten the salt with water some-

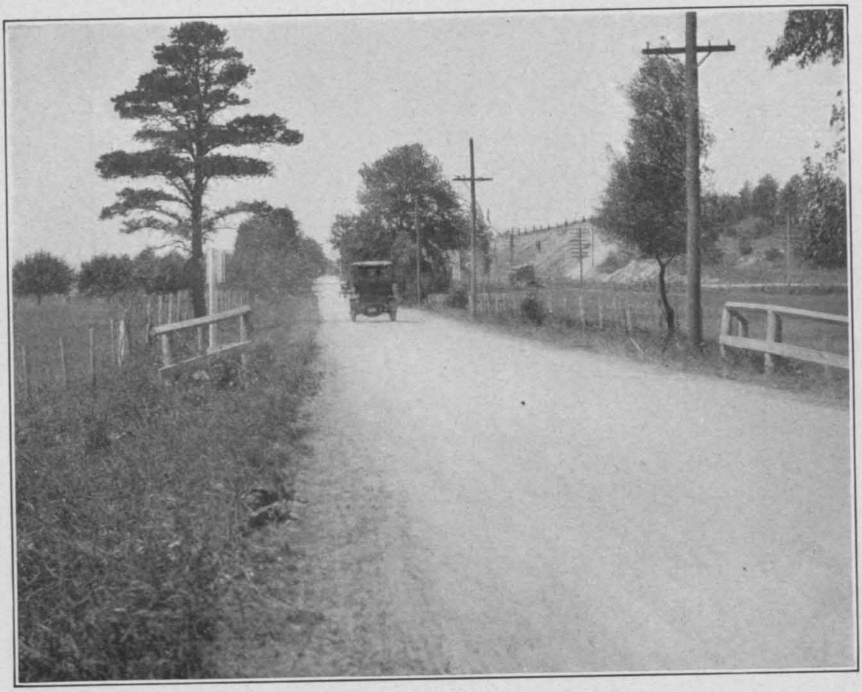

FIG. 1.—ROAD TREATED WITH ONE APPLICATION OF AN OIL EMULSION.

[The automobile is traveling at the rate of 40 miles an hour, with no resulting dust.]

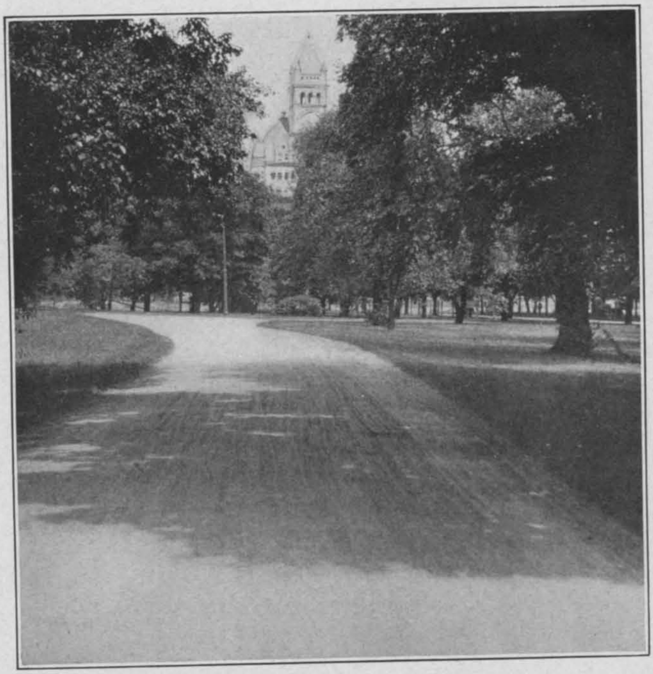

FIG. 2.—ROAD TREATED WITH CALCIUM CHLORID IN GROUNDS OF DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

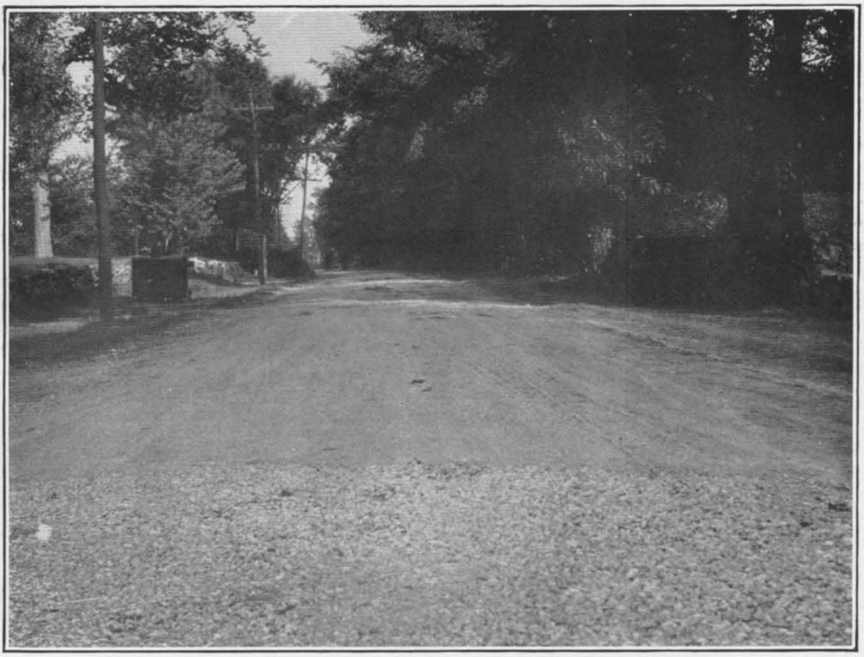

FIG. 1.—NEWLY RESURFACED MACADAM ROAD AFTER TREATMENT WITH A TAR PREPARATION. UNTREATED PORTION IN FOREGROUND.

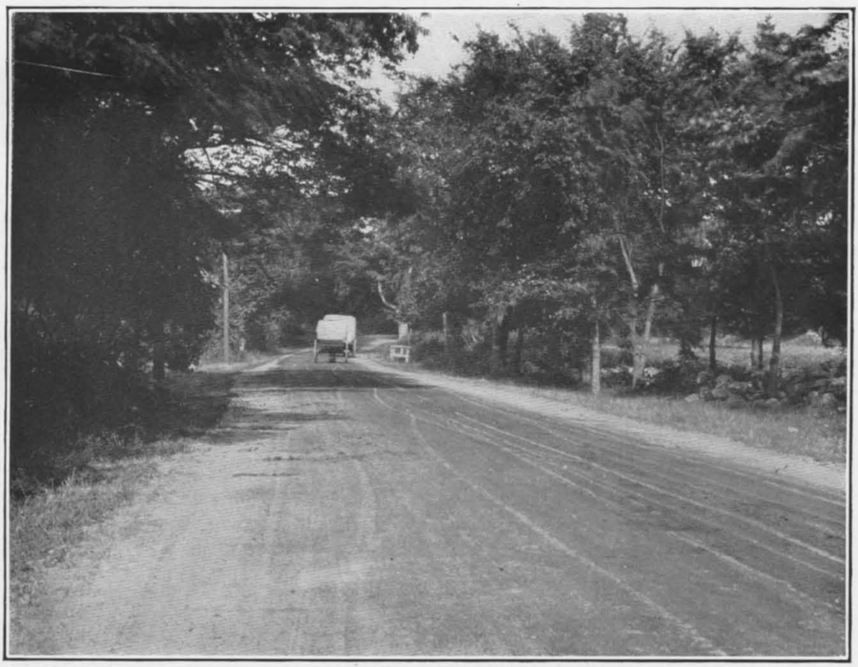

FIG. 2.—MACADAM ROAD TREATED WITH WATER-GAS TAR.

times as often as once a day, whereas if water alone were used it would be necessary to sprinkle the road three or four times a day to get the same result. During the night and early morning moisture is absorbed and stored up by the road surface, and if the day is not too dry and hot and the road is somewhat shaded the moisture thus absorbed will lay the dust until evening, when the process of absorption is repeated. (See Pl. XXIV, fig. 2.)

A number of preparations have lately appeared on the market which contain oils, tar, or asphalt so treated as to be readily emulsified with water. Emulsions thus formed are usually due to the presence of saponified bodies, which are produced by the action of alkalies upon oils or other fatty organic compounds. These emulsions diluted so as to contain only a small percentage of base are applied to the road surface by means of a sprinkler at more or less frequent intervals, depending upon local conditions. Some of these compounds have given good, though for the most part temporary, results in the localities in which they have been tried, but as they are usually quite expensive and are dependent upon a ready water supply their use is limited. For parks and suburban roads they are often advantageous to road users and near-by dwellers, for when frequently applied they undoubtedly hold down the dust better than the heavier substances, such as coal tar and oil; but as the mud formed in wet weather is often disagreeable and injurious to vehicles and clothes, their use is not without some drawbacks. (See Pl. XXV, fig. 1.)

In reviewing the patents dealing with this class of compounds one is struck with the variety of substances which are employed. In order to give some idea of their preparation and composition a few of these compounds will be briefly described. An emulsion of oil, preferably asphaltic in character, made by the addition of ammonia, is perhaps the simplest type of these preparations. Another consists of a mixture of any oleaginous substance with a small amount of carbolic acid, which makes an emulsion without saponification when water is added. To this emulsion asphaltum, tar, and glycerin refuse are added. A French patent covers the use of an alkaline solution of casein in water, to which has been added asphalt, tar, or other bituminous body softened by heat, and a sufficient quantity of water. A mixture of rosin, coal-tar creosote, caustic soda, and water has also been patented. Some attempts have been made to utilize waste products from various industries as dust layers, among which might be mentioned a combination of wool fat, alkali, creosote, and water, and a preparation of water lyes, obtained from wood-pulp manufactories, containing resinous and salt ingredients.

Before leaving the subject of solutions and emulsions it may be well to mention a product which, while not strictly belonging to this class of preparations, should be considered in connection with them,

owing to the similarity in number and method of applications sometimes employed in its use on roads. This substance is known as water-gas tar and is obtained as a by-product in the manufacture of water gas. It is an oily liquid much thinner than coal tar and can be easily applied by means of a sprinkler. It has a rather disagreeable odor, which, however, is not lasting and therefore not a serious objection to its use. When applied in large quantities it may be classed with coal tar and the mineral oils in regard to the permanency of its results. Used in this way it has proved to be a good dust preventive, but not so good a road builder as coal tar and the heavier oils. (See Pl. XXV, fig. 2.) When applied in smaller quantities and more frequently it compares well with the salt solutions and emulsions.

It may be readily seen how difficult a matter it is to compare properly the relative values of the different materials which have been used for the purpose of dust prevention. In certain localities the use of one of these materials is often claimed to be more satisfactory than others. Whether this is due to skill in treatment or to local physical conditions, it is impossible at present to say. In estimating the relative cost of dust prevention by various materials, it must be borne in mind that any substance which prevents the formation of dust, and holds that already formed on a road surface, greatly lengthens the life of a road and consequently lowers the cost of maintenance. This precludes the obtaining of accurate cost data at present, as it can only be had after a sufficient length of time has elapsed to determine the saving in repairs to the road from the use of dust preventives. The entire subject is still in an experimental stage, and where a community wishes to have work of this kind carried on, the advice of some experienced person, familiar not only with one preparation but with many, should be sought in order to avoid costly mistakes and the repetition of failures made in other places. For this reason many towns and cities are trying a number of preparations on a small scale to determine which is best suited to their needs, and yet it is not uncommon to find that those who follow this method often disparage the use of materials which have proved unsatisfactory for their purposes without considering that under different conditions excellent results might be obtained. This fact may account for the many contrary opinions held by road engineers.

To relieve this condition the Office of Public Roads is collecting and correlating all available information on the subject, as well as conducting experiments.

THE WEATHER BUREAU AND THE PUBLIC SCHOOLS.

By John R. Weeks,
Local Forecaster, Weather Bureau, Binghamton, N. Y.

During the school year a million or more children of the public schools make weather observations and study the daily weather maps and forecasts. From its earliest days the Weather Bureau has cooperated to some extent in public school work, and during the past ten years this cooperation has been widely extended. The public schools and the Weather Bureau have a mutual interest in the matter. The school authorities have found in the study of the weather with the assistance of the Weather Bureau a means of satisfying part of the requirements of modern methods of study; and the Weather Bureau is able through the schools gradually to dispel popular superstitions and fallacious beliefs that have hampered its work, and to instill in the public mind a better understanding of the purpose and limitations of its work, enabling both the commercial and the agricultural world to make more intelligent and more complete use of the forecasts, special warnings, weather maps, and climatological publications.

CHANGES IN METHODS OF TEACHING.

The introduction of the study of the weather through the entire school course, from the primary department to the high school, has been the result of a gradual change that has taken place in methods of teaching. Whereas under old systems the energies of the teacher were mainly given to strengthening the memory of the scholar and cramming him with dry facts, more or less accurate, now the endeavor is not only to stimulate the memory but to cultivate to a high degree of perfection the powers of observation and creative imagination. So far as the mere accumulation of facts is concerned, the student is led to acquire his store of information as much as possible from his own observations along practical lines, under the direction of the teacher. Thus the so-called "laboratory system," by which knowledge is acquired through experiment, and which was formerly confined to colleges and universities or to special studies in a few of the more advanced high schools, has been carried down to the primary grades, with the result that the boys and girls are brought to a more practical knowledge of natural conditions surrounding

them and governing their lives; and those that do not enter the high school are not entirely cut off from a study of nature. While the older methods were deserving of much adverse criticism, the newer methods are worthy of commendation. To quote from Professor Huxley:

Suppose it were perfectly certain that the life and fortune of every one of us would, one day or other, depend upon the winning or losing of a game of chess. Don't you think we should all consider it to be a primary duty to learn at least the names and moves of the pieces; to have a notion of a gambit, and a keen eye for all the means of giving and getting out of check? Do you not think that we should look with disapprobation, amounting to scorn, upon the father who allowed his son, or the state which allowed its members, to grow up without knowing a pawn from a knight? Yet it is a very plain and elementary truth that the life, fortune, and happiness of every one of us, and more or less of those who are connected with us, do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game that has been played for untold ages, every man and every woman of us being one of the two players in a game of his or her own. The chessboard is the world, the pieces are the phenomena of the universe; the rules of the game are what we call the laws of nature.

Much has been said in recent years, particularly in Eastern States, about abandoned farms and the migration of country youth to the cities. It is believed by many educators that this introduction of nature study throughout the school course, in country as well as city, will stimulate a love of nature which will help to counteract this unfortunate tendency.

METEOROLOGY IN THE ELEMENTARY SCHOOLS OF NEW YORK STATE.

As will be seen, this change in method has given meteorology a somewhat unique position in the school curriculum. Observations and study of the weather commence in the first year, before the child can read, and are continued until the high school is reached. To show this in detail the following is quoted from the New York State Regents' Syllabi for Elementary Schools (1906), which are used in the schools of the State, omitting here those portions that do not apply to the subject in hand:

NATURE STUDY AND AGRICULTURE.

First Year.

Natural phenomena: Daily observations of the weather recorded by the teacher in the class calendar.

Second Year.

Natural phenomena: Water and its forms, observation of qualities of water, ice, steam; observation of winds—force, visible effects; observation of clouds—motion, color, portent; weather conditions noted and recorded.

Third Year.

Natural phenomena: Observation of winds—force, direction, visible effects; observation of clouds—motion, color, what they foretoken; observation of the

progress of a storm; the rainbow; the sun as a source of light and heat, its rising and setting, day and night; the moon—light, rising and setting, phases; weather conditions noted and recorded. Positive, direct, discriminating, accurate observations should be required.

Fourth Year.

Natural phenomena: Sun—effects of heat and cold on water, on the soil, on plant and animal life; changes of seasons; heat, light; rising and setting of the sun; observation of the changes of the seasons; experimental illustrations of melting, freezing, evaporation; observations of the weather and record kept; temperature noted and record kept. The work in this year is closely related to the observational work beginning the study of geography.

Fifth Year.

Natural phenomena: Observation of the seasons; weather observations; the barometer; effect of change of seasons on plants and animals. The habit of searching for the causes of phenomena should be formed, and the ability to explain natural events should be developed.

Sixth Year.

Natural phenomena: Weather observations, use of the weather maps, signals, forecasts; affairs of agriculture; Government helps.

GEOGRAPHY.

It is to be remembered that an ordinarily bright child comes to school with a certain body of geographic information picked up from observation or through conversation with its elders. In the nature-study course of the first two grades, also, much work of a semigeographic character is proposed. With the beginning of the third school year the child has usually learned to read a little, but scarcely well enough to be self-helpful.

Third Year.

During the entire third year, if the work is not provided for in the nature-study course, simple weather observations should be made and records kept by the children. A text-book should not be used until the last quarter.

Fourth Year.

Climate of United States: Show the position of the United States on the globe; point out that the northern part is near the Arctic zone; locate the home, village, or school; have the children describe the usual weather conditions during the summer and winter; give some simple lessons on evaporation and condensation of moisture; explain how moisture evaporated over the surface of the sea is borne by winds into the interior to be condensed and fall as rain; make maps showing the distribution of rainfall in the United States; have children locate on larger maps the regions of (1) abundant rainfall, resulting in much vegetation where it is warm; (2) medium rainfall—enough so that crops will grow; (3) slight rainfall or none, resulting in deserts.

As a result of the relief, temperature, and rainfall, it will be found that different parts of the United States are suited to certain industries; i. e., they furnish certain possibilities of occupation. (Then follows a study of the different divisions with regard to industries. Other countries are studied in the same way, but with less detail.)

Fifth Year.

Similar studies of foreign countries, etc.

Sixth Year.

The work is more largely in physical geography, showing the world, not as a mere assemblage of places and things, but as a world of order and unity, where the different life forms and their environment are adapted to each other.

The land and water in relation to atmospheric movements: Conditions shaping relief features and shore forms; change in temperature; work of winds; dissolving action of atmospheric moisture; winds, tides, and the work which they do.

The air and conditions which determine temperature: (1) revolution of earth about the sun; (2) inclination of earth's axis; (3) the relation of these facts to climate—(a) unequal length of days and nights, (b) seasons, (c) location of the tropics, polar circles, zones; (4) modifying influence of large water bodies; (5) modifying influence of highlands; (6) actual conditions resulting from these influences.

Atmospheric movements (winds): (1) Equatorial belt of calms; (2) trade winds; (3) horse latitudes, or belt of tropical calms; (4) westerlies—(a) general movement, (b) cyclonic storms; (5) seasonal winds; (6) ocean currents and causes.

Rainfall to be studied in connection with the foregoing. Account should be taken of the nature of the rainfall in the different wind zones and calm belts and the influence of elevation upon a body of moist air, regardless of the cause of elevation.

Climate—Outline to be used as a guide in the study of the several continents and countries: (1) Temperature as controlled by (a) position, (b) relief; (2) winds and rainfall—(a) prevailing winds and calm belts to be expected from position, (b) winds actually prevailing, (c) influence of highlands upon winds and rainfall, (d) influence of winds upon ocean currents and of the currents upon winds which cross them, (e) location of rainless areas and the reasons therefor.

Zones of vegetation as dependent upon: (1) Temperature as determined by latitude, altitude, proximity to large bodies of water, and influence of ocean currents; (2) rainfall; (3) character of the soil.

Zones of waste as dependent upon: (1) Lack of moisture; (2) too much moisture.

Seventh Year.

Work continued along the same general lines.

Reference books used in entire course—Standard text-books; daily weather map, and other publications of United States Weather Bureau.

ADVANCED CURRICULA IN HIGH SCHOOLS.

In the high schools meteorological instruments, the properties of the air, and the movement of the atmosphere are studied in the physics course, the weather and its influence on plant life in both botany and agricultural courses, and the weather and climate in considerable detail in the physiography course. A few high schools also offer elementary meteorology as a special subject. In colleges and universities courses in meteorology of greater or less scope are given, adapted

in some instances to special purposes, such as engineering or medicine. In all of this work the Weather Bureau has a part.

PURPOSE AND VALUE OF METEOROLOGY IN SCHOOL WORK.

In addition to what has already been said in regard to the purpose and value of meteorology in school work, there are other practical considerations that should be mentioned. Briefly, all out of doors is the laboratory, and the teacher is never at a loss for laboratory material. The subject is one of interest and speculation to everyone, from the youngest boy or girl who watches the clouds and rain to the university student who studies medical climatology or some other specialized application of weather knowledge. The service of the Government is, so far as practicable, at the command of the teacher. The teacher may receive the publications free; may obtain special data or information or advice by mail or by visit to the nearest local office; may take the class to the local office of the Weather Bureau and have them hear a lecture on the instruments and work; or may receive instruction from a Government official at college or university. The subject offers unexcelled opportunities for strengthening the powers of judgment and observation of the student. City and country schools are on a common ground, neither having the advantage of the other.

THE WEATHER MAP IN SCHOOLS AND OTHER AIDS GIVEN TO TEACHERS.

The daily weather map is the publication most widely used in all grades. In New York State about 529 schools or schoolrooms are supplied with the map each day, and it is, as a rule, displayed in the corridor for the benefit of all students, as well as used for class study. An oak frame for the purpose is furnished by the Bureau. The number of maps issued for school purposes in New York State daily comprises about 15 per cent of the total issue, and it is believed that this per cent applies at the present time throughout the country; at least this view is supported by the writer's experience in Montana, Arkansas, Mississippi, Alabama, and Georgia. This would make the number of schools or schoolrooms supplied daily in 1907 nearly 4,000. The number increases each year. In New York State a fair estimate places the total number of public-school children having access to the weather map each day at 175,000. Other publications of the Weather Bureau, such as the Weekly and Monthly Climatological Reports of the separate States and the United States, the Monthly Weather Review, and the Weekly Snow and Ice Bulletins, are much used, but their distribution is not as general as that of the weather map. In many instances, particularly in country districts, teachers act as cooperative observers of the Weather Bureau and are loaned the necessary instruments. Certain necessary conditions must be com-

plied with, however, before this can be done. Instruments of the standard Weather Bureau pattern may be purchased at a moderate cost. All the normal schools of New York State are provided for in one of these ways.

SIMPLE HOMEMADE INSTRUMENTS.

Several of the more important instruments used in weather observation can be made at home by the pupils or teacher, and such homemade instruments are of greater educational value than the more elaborate ones that can be purchased. They will not, of course, give accurate records, but they can be made to work, and will interest the boys and girls. The anemometer, or wind measure, for instance, can be imitated by any bright boy at a cost of 20 or 30 cents, as illustrated in figure 31, the ribs of a broken umbrella being used for the cross arms and vertical spindle and the halves of two baby's ball rattles for the cups. These are made of paper, celluloid, or rubber, and can be purchased at any toy store. A size about 4 inches in diameter should be selected. The distance from the vertical axis to the center of the cups should be 6¼ inches, and the length of the vertical axis should be about 12 inches. The bottom of the shaft should rest on a piece of glass, to reduce the friction, and a couple of small screw eyes fastened in a wooden upright may serve as bearings. A counter may be made out of two wooden disks and nine small wire nails, as indicated in the sketch. If the instrument is properly constructed, the number of revolutions of the larger disk in a minute will correspond approximately to the number of miles per hour that the wind is

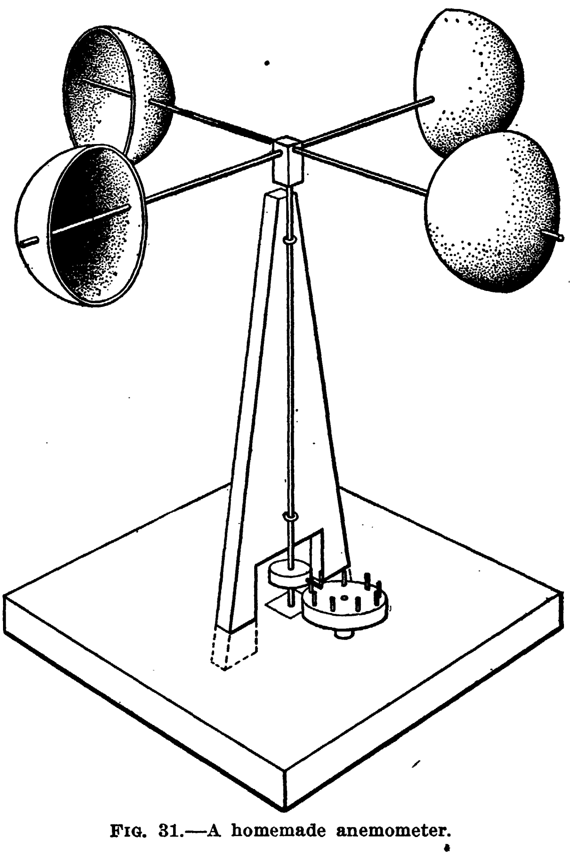

FIG. 31.—A homemade anemometer.

blowing. About 540 revolutions of the cups will measure a mile of wind.

To determine the number of revolutions of the wheel, if a watch is not at hand, seconds may be counted, and this is a valuable exercise for the children. To count seconds, say "one-half and one," "one-half and two," "one-half and three," and so on, at an ordinary conversational rate of speed, up to 60 (one minute), then begin over again for other minutes.

A photographic sunshine recorder may be made out of a large baking-powder can and some blue-print paper, on the principle of a pin-hole camera. The space in the can should be divided by a partition running lengthwise (fig. 32) into halves, one for the morning record and one for the afternoon, with a pin hole for each. The blue-

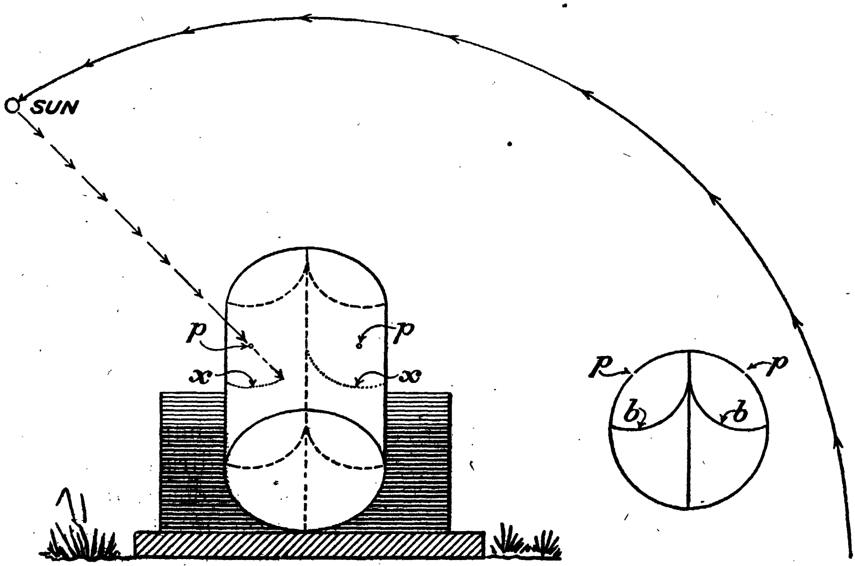

FIG. 32.—A homemade photographic sunshine recorder: *b*, curved sheets of blue-print paper; *p*, pin holes; *x*, line traced on blue-print paper by sun's rays.

print paper should be curved to the arc of a circle (*b*) of which the pin hole (*p*) is the center. The partition wall in the can may be made of tin or of pasteboard. The sun shining through the pin hole will trace a line (*x*) on the blue-print paper, and this line will be broken by clouds. To show time the pin hole may be covered for a few minutes at the beginning of each hour for one day, and, if the instrument is properly constructed, the hour lines thus found will be the same as for other days. To obtain several days' record on one sheet the blue-print paper may be slipped upward a little each morning or evening, or several pin holes that can be uncovered consecutively may be used. A can 5 or 6 inches in diameter will give the best results. The blue-print paper may be purchased of any dealer in photographic supplies for a few cents.

A simple barometer is easily made as illustrated in any text-book of physics, but the cost of mercury and tubing is somewhat too great for the average schoolboy and the results attained are not especially interesting.

Any cylindrical can with straight sides may be used for a rain gauge, but the smaller the size the less accurate will be the measurement. The standard pattern is exactly 8 inches in diameter inside. For greater ease and accuracy in measuring the depth of the rainfall, a measuring tube is used that is exactly 2.53 inches in diameter, which magnifies the depth of the water 10 times. If you have a suitable can for a gauge and wish to have a measuring tube made for it that will magnify the amount 10 times, measure the exact inside diameter of the can, square this, divide the result by 10, and extract the square root. The result will be the inside diameter of the measuring tube. Suppose the diameter of the can is 8 inches; 8 squared equals 64; this divided by 10 equals 6.4, of which the square root is 2.53, which is the diameter of the tube in inches.

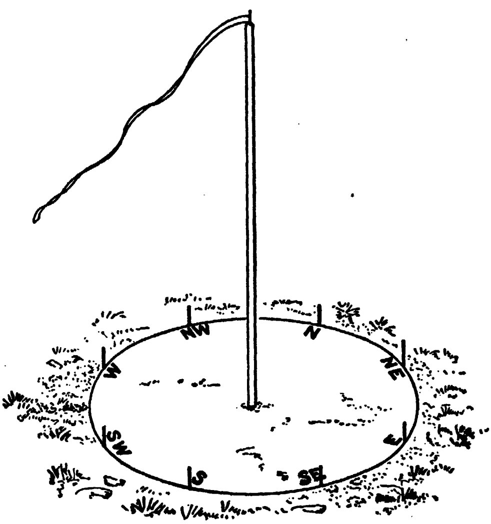

FIG. 33.—A simple device to show the direction of the wind.

A very simple device to show the direction of the wind, and one that is useful even in the primary grades, is a vertical stake standing several feet above the ground (fig. 33). A nail is driven into the top, to which is attached a long thread or narrow ribbon. The thread will be blown by the wind and show its direction very accurately. A circle may be drawn in the sand or dirt around the stake and the points of the compass indicated on this by stakes or marks. The direction of the streamer may be marked in the dirt at intervals during the day and the children led to note the changes in the direction of the wind.

Thermometers are so easily obtained that no special mention is needed.

LANTERN SLIDES AND THEIR USE.

The great popularity and increased cheapness and convenience of amateur photography have brought the stereopticon into more general use in class work, and a majority of the city schools and many coun-

try schools have lecture rooms fitted for this purpose or have the simple gasoline outfits that may be purchased quite cheaply. Where electricity is available, there is no better or more convenient way of presenting large charts that are needed for the study of an entire class than by means of the stereopticon, the room being sufficiently darkened by pulling down the curtains and a sheet being unnecessary where a white wall is available. Photographic copies of the most complicated charts may be purchased in the form of lantern slides for 25 to 50 cents, when the originals of sufficient size for the schoolroom would cost as many dollars and would soon be worn out, besides being cumbersome and inconvenient. In New York the State department of education maintains a division of visual instruction which expends about $20,000 annually in the preparation of lantern slides and their distribution to the public schools of the State. These are deposited in the schools for class-room use, or sets of them are loaned to teachers and superintendents for lecture purposes. Here, too, the Weather Bureau has assisted by furnishing a lecture on The Weather, What It Is and How It Is Observed and Forecast, which is sent free of expense from the local office at Binghamton, N. Y., to schools in the State upon request, the only conditions being that the lecture shall be public and that no admission fee or collection of any kind shall be taken. This is the only lecture of the kind that has been used by the State department of education. The demand for the lecture during 1906 and 1907 was three times as great as could be met.

At the central office of the Weather Bureau in Washington, D. C., also, is kept a collection of slides, from which loans are made to station officials when they desire to give illustrated lectures of a public nature. Many such lectures are to teachers at summer institutes, normal schools, colleges, or public gatherings, and have proved very popular.

THE FORECASTS AS USED IN SCHOOL ADMINISTRATION.

The health and comfort of school children demand constant consideration, and the daily forecasts are carefully considered in school administration. During, or on the approach of, inclement weather it is common for school superintendents to consult the weather forecasts and warnings or to telephone to the local office of the Weather Bureau for advice in planning to dismiss the school for the day or prepare for a double session. In the larger cities especially the schools are all connected by telephone and arrangements for a double session can be quickly made upon the advice of the local forecaster, or the schools can be dismissed. In the rural districts the farmers' telephone lines place the warnings of heavy

snow, blizzards, cold waves, etc., at the disposal of the country school quickly and without expense, since the forecasts are in most instances distributed free to their patrons by the telephone companies.

The janitor, too, watches the forecasts closely so that he may not be taken unawares by rapid changes in temperature and thus let the rooms become too cold or too warm for the health and comfort of the pupils. He needs also to take account of the conditions of rain or snow in planning his work.

Sometimes it becomes advisable to close the schools entirely upon receipt of Weather Bureau information. Thus on the western prairies the schools may be closed when a blizzard is expected; in New England or elsewhere, when heavy snow is on the way; in the far South, when snow sets in to continue until the ground is covered, so that the children may join with their parents in frolicking and enjoying to the utmost the unusual pleasure. In the fruit district of California, where thousands of tons of raisins, apricots, prunes, etc., are dried outdoors in the sun, the schools are closed upon receipt of a rain warning, in order that the children may at once be put to work covering up the trays of fruit to prevent loss.

SUMMARY.

Modern methods of teaching in the public schools provide an important place for weather study and make liberal use of the publications of the Weather Bureau and the local officials and offices. This use begins in the primary department and ends with the colleges and universities. The policy of the Weather Bureau, under the direction of the Secretary of Agriculture, has been to assist the public schools as far as its resources and general duties to the public will permit. About 15 per cent of the daily issue of weather maps is used in the public schools and it is estimated that about 4,000 schools now receive them, and many of these have files preserved from past years. Lectures are given by Weather Bureau officials at teachers' institutes and elsewhere, and, in many instances, regular courses of instruction are given by them at colleges and universities. Classes from the public schools visit the local offices of the Weather Bureau. The forecasts and warnings are widely used in school administration.

CUTTING TIMBER ON THE NATIONAL FORESTS AND PROVIDING FOR A FUTURE SUPPLY.

By Raphael Zon, *Chief, Office of Silvics, Forest Service*, and E. H. Clapp, *Chief, Office of Forest Management, Forest Service.*

GOVERNMENT TIMBER SALE POLICY.

The present timber sale policy of the Government on the National Forests is of very recent date. Its development, however, has been gradual and a logical and necessary outcome of the change in the timber conditions of the West. It forms a most interesting chapter in the history of the public land policy of this country. There have been three stages in the Government policy of dealing with the timberland on the public domain, each of which has left distinct marks on the condition of the cut-over land and on the kind of forest that such land will produce:

(1) The period prior to the act of Congress of June 4, 1897, which gave the Secretary of the Interior authority to sell timber from the forest reserves.

(2) The period from the act of June, 1897, to the transfer of these forest reserves to the Forest Service of the Department of Agriculture on February 1, 1905.

(3) The period since the transfer of these Forests to the Forest Service.

THE FIRST PERIOD.

Before the creation of the forest reserves there were laws which dealt with the disposal of timber on the public domain. Several of these laws are still in force on that part of the public domain which is not included in National Forests.

The timber and stone act of June 3, 1878, was the first law which recognized the fact that standing timber has a value in itself apart from the land on which it grows, and that the Government has the right to sell the land for its timber.

The act provided for the sale of tracts not to exceed 160 acres to any purchaser, at $2.50 per acre. Under it cultivation of the land or residence on it was not necessary, but the applicant was required to testify that the land contained no precious minerals and was more valuable for its timber or stone than for any other purpose. The value of a large proportion of the lands which were patented under this act depended upon their timber. When this timber was cut the small trees which remained were usually killed by fire, and much of the land became a barren waste.

Another act of the same date (20 Stat., 88) dealt with mineral lands, and permitted the cutting and removal of timber for building, agricultural, mining, or domestic purposes from such lands within several of the public-land States and Territories.

The Commissioner of the General Land Office issued a circular of instructions to cover the cutting of timber under this act. Briefly, it confined the uses which might be made of the timber to those named in the act, though it provided further that no timber should be used for smelting purposes, that no trees less than 8 inches in diameter should be cut, and that persons who cut timber must dispose of the tops, brush, and other refuse in such a manner as to prevent forest fires. It was impossible, however, to enforce these regulations, chiefly because of the small force of men available. Upon practically all of the cut-over areas the brush was not properly disposed of, and repeated fires followed, killing all the timber which had been left.

Under the act of March 3, 1891, as extended by the act of February 13, 1893, the Commissioner of the General Land Office issued a circular of instructions to regulate the cutting of timber on non-mineral lands. This circular provided that timber might be procured in certain of the public-land States and Territories from unoccupied, unreserved, non-mineral public lands, for firewood, fencing, building, or for other agricultural, mining, manufacturing, or domestic purposes, but not for sale or disposal. The cutting of the timber or lumber was, however, limited to an amount not to exceed a stumpage value of $50 in one year by one person or association without a permit. This law is still in force, but it has been impossible to supervise the cutting of timber under it, and, in consequence, large areas of valuable forest land have been ruined.

A larger part of the timber on the public domain, however, was cut under acts of Congress which were not primarily intended to deal directly with the disposal of timber, but to induce settlers to locate in the West, build homes, and cultivate the land. Thus the Homestead Law of May 20, 1862, granted an area not to exceed 160 acres to each settler who would occupy and cultivate the land for five years. While this law proved very beneficial in building up the prairie section of the Middle West, when applied to the timbered lands of the public domain it became in a great many cases merely an instrument to remove the timber without developing the country or bringing any return to the National Treasury. The commutation clause of this homestead act, under which, after a residence of fourteen months and a cash payment of $1.25 per acre, an absolute title to Government land could be secured, was frequently taken advantage of to obtain patents to lands which were afterwards turned over to corporations and large lumber companies. Thousands of acres obtained in this manner have since been cut over and abandoned.

The lieu land clause of the forest reserve act of June 4, 1897, now repealed, enabled many persons and companies to exchange hundreds of thousands of acres of worthless mountain wastes for valuable timberland, because their original grants had been included in areas set aside as forest reserves. A great deal of the timber so acquired was recklessly cut without any regard for the future of the forest.

In addition, the inadequate supervision of the timbered lands on the sparsely populated public domain offered many opportunities for illegal cutting of timber and for trespassing without detection or punishment. Since it was not possible to secure timber in a regular and open manner various legal disguises were resorted to in order to obtain it, or else it was simply felled without any attempt at legal disguise whatever. This, together with the inability of the force to insure the proper execution of the regulations, resulted in an entire lack of care for the remaining forest or provision for new growth.

As a result of such methods there are now within the 150,000,000 acres of the National Forests in the United States approximately 7,000,000 acres of land which had been burned over and nearly 1,500,000 acres which had been cut over previous to their withdrawal. In the area classed as burned land, which will require many decades to recover from the treatment it received, there are undoubtedly a large number of old cuttings, since lumbering during this period was almost invariably succeeded by fires, which often spread over large adjoining areas and obliterated the traces of lumbering. Fires were often set deliberately to cover trespass cuttings.

The consequences of destructive cuttings are to be seen everywhere through the National Forests, but especially in the lodgepole pine region of the middle Rocky Mountains, where the demand for timber was great. Thus around some of the mining centers near Butte, Mont., large areas were cut over under real or pretended compliance with the provisions of the act of June 3, 1878. Smelters were established in Butte in the early eighties, and as coal was not then available, wood was used for fuel. This, together with the immense quantities used for mining timber, has been a great drain on the forest resources of the region. Wood of all sizes was utilized, and in the tall, dense stands of lodgepole pine on the rounded hills and slopes of this region, clear cutting was the rule. On what is now the Helena National Forest it is estimated that 140,000 acres (218 square miles) were cut over and 3,000,000 cords taken out before the creation of the reserve. Most of this cutting was done before 1897, and in the vicinity of Butte a great deal was done before 1877. No limit except hauling distance was placed on the size of the areas cut clear. Along all the principal streams and creeks clear cuttings extend back from 1 to 3 miles. In some places spurs were run out from the railroads. On Mike Renig Creek, for instance, a spur

track was built up the creek 7 miles and the slopes were stripped clear for from half a mile to 2 miles on each side.

Seed trees were left only by accident, and then on rocky knolls or other inaccessible points. Since no provision whatever was made for the future forest, only 50 per cent of the area is now covered with any reproduction, and less than one-half of this, or 25 per cent of the whole area, will produce a forest as good as the one cut. On the areas which contain only an irregular reproduction and which have been swept by fires it will require many years to produce a forest. Owing to the absence of seed-bearing trees, the few scattered seedlings now present must grow up and bear seed before the areas can be fully restocked. The most striking and desolate appearance is presented where successive fires have swept the ground. In such districts there is no reproduction whatever; nothing but charred stumps and a thick sod of grass or chaparral on the slopes and ridges, which were once covered with stands of trees. Some of these tracts were cut more than twenty years ago, and yet there is no sign of a returning forest. If planting is not resorted to they will remain in the same condition for many years to come.

On the Hell Gate National Forest near Anaconda there is an old clear cutting of 8,000 acres made about twenty years ago. Since then 7,000 acres of this area have been twice swept by fire, and are now without a seedling of any kind.

There are many such tracts, large and small, on the National Forests, especially around mining camps. Occasionally there are areas covered with excellent reproduction, but these are due to accidental combinations of favorable conditions rather than to the methods of cutting. Many areas which were not cut clear and escaped fire contain now a fair reproduction, but usually of inferior species, since the more valuable species were cut out and the poorer ones left to propagate. Unrestricted grazing, especially of sheep, helped to keep down the reproduction on the cut-over areas.

It is not an exaggeration to say that 75 per cent of the old cuttings and burns will for a long time remain unproductive, and a portion of them will never have forest growth again, unless artificially reforested.

THE SECOND PERIOD.

The second period extends from the act of June 4, 1897, to the transfer of the National Forests to the Department of Agriculture.

Although the act providing for the establishment of forest reservations passed Congress on March 3, 1891, no real relief to the situation resulted until 1897, since the bill did not carry with it any appropriation for the care and the protection of the Forests. It is the act of June 4, 1897, that must be considered the turning point in the Gov-

ernment timber-sale policy. This law provided for the control and administration of the forest reserves and authorized the Secretary of the Interior to sell timber from them. The laws under which timber could be secured from the public domain were not applicable to the forest reservations, but any person who needed timber for local needs could obtain it by purchase from the Government at prices which were as nearly as possible the actual value of the timber. No timber could be exported from the State or Territory within which the forest reservations were located, and in this way all the timber sales were limited exclusively to local demands.

The timber was to be sold under rules which the Secretary of the Interior was authorized to prescribe. The regulations which were framed consisted mainly in forbidding clear cutting and compelling the leaving of some trees for future reproduction, in preventing waste by ordering closer utilization of stumps and tops, and in directing the disposal of brush by piling or burning in order to safeguard against forest fires. In many cases, however, even these rules remained practically without power, because there were no technically trained foresters to outline proper regulations for cutting and a very inadequate force of rangers to compel obedience. Yet the condition in which the cuttings were left during this period shows a marked improvement over the previous period.

The policy of the Government with regard to the Forests during this period was not, as it is now, to encourage the fullest use of the land, but almost exclusively to preserve them for the future. This tendency was thwarted to a very considerable extent by determined consumers who cut the timber without permission, in many cases practically regarding the trespass penalties as merely a part of the business transaction of securing the wood. The trespass cuttings were five times as large as the legitimate timber sales. The receipts for sales during the period between June 4, 1897, and June 30, 1904, amounted to only $203,245.87.[a]

THE THIRD PERIOD.

The third period begins with the transfer of the National Forests to the Department of Agriculture.

The general timber-sale policy of the Forest Service at the present time, as determined by acts of Congress and regulations approved by the Secretary of Agriculture, is briefly as follows: The sale of dead timber is everywhere encouraged. Live timber is sold, except where its removal would make a second crop doubtful or would reduce the

[a] While the National Forests were not transferred until February 1, 1905, the report for the entire fiscal year ending June 30, 1905, was made by the Department of Agriculture.

supply so that there would be danger of not meeting local demands, or where injury to streams might follow. With a few exceptions the timber may be exported from the State or Territory in which it is cut. In order to give as much publicity as possible to the sales, the law provides that sales amounting to more than $100 must be advertised for a period of at least thirty days. In each sale the purchaser is required to execute a contract which contains the special regulations under which the cutting must be done. A reasonable time, depending upon the amount of timber included in the sale and the facilities of the purchaser for handling it, is allowed for the completion of the contract, but in no case can this exceed five years. Great care is exercised in awarding sales to prevent a monopoly of the lumber market in any district. In order to prevent the purchase of timber for purely speculative purposes, it is also provided by law that no contract is transferable, and contracts in which a period of more than one year is allowed for the cutting provide that a definite amount of timber must be cut and removed each year. Since the law requires that the full stumpage value of all timber must be obtained, the minimum stumpage rates provided for in the advertisement are, as nearly as can be determined, the full value of the timber. For the past year the cut on some of the Forests on which the timber supply is limited has been restricted, and the annual cut on all the Forests is being definitely limited as fast as the necessary data on which to base this action can be collected. In some Forests sales are limited to the purely local markets, and in a few cases it has been necessary to restrict the annual cut to an amount below the local demand. It is an interesting fact that stumpage rates in Forests which supply a purely local demand are considerably lower than in those Forests from which the lumber is sold in the general market. In this way the Forest Service is able to be of material assistance to the home-builder.

When an informal application for timber is received by an officer in charge of a Forest, he details men as soon as possible to make an examination of the timber tract. In the more important sales, wherever possible, technically trained foresters are assigned to make this examination.

The first consideration is to determine whether or not the sale should be made. The decision depends upon the condition of the timber itself, whether or not reproduction may be expected to follow the cutting, the price for which it may be sold, the necessity for the protection of watersheds, and the reservation of timber for local use. The examiner, after determining the advisability of the sale and the amount of timber, fixes the boundary of the cutting area and formulates the plan under which cutting shall be done. The examination

includes also a careful study of the cost of logging and of market conditions, in order that the true value of the timber may be decided upon for advertisement. Small sales are handled almost entirely by the local force of the Forest. Large sales require the approval of the Forester. In sales amounting to more than $100, at the expiration of the required thirty days' advertising the timber is awarded to the highest bidder, and a contract containing the cutting regulations is prepared. Cutting may begin as soon as the contract is executed.

When the sale has been awarded, the cutting is placed under the direct supervision of one or more Forest officers. The boundaries of the sale area are carefully blazed. All live trees which are to be cut are marked and stamped "U. S." below stump height, and, if the cutting is to be done while there is deep snow on the ground, a second mark is made 3 or 4 feet from the ground. The mark on the stump is used as a check to determine if any trees other than those specified are cut. When Government regulation was first introduced, there was decided opposition among lumbermen and purchasers to the requirement that all trees cut must be fully utilized. During the past year, however, there has been a decided change of opinion (see Pl. XXVI), and now many lumbermen are heartily cooperating with the Forest officers to secure as complete utilization as possible, and are even adopting Forest Service methods on their private holdings.

It is the duty of the officer supervising a sale, in addition to marking the timber for cutting, to see that only this timber is cut and to require that all brush and débris be disposed of according to the terms of the contract. In order to maintain a careful check in the administration of timber sales, inspection is made from time to time by inspectors specially detailed for that purpose, and no sale is considered closed until all the requirements of the contract are fulfilled.

In order to obtain as complete utilization as possible and at the same time improve the silvicultural conditions of the Forest and reduce the danger from fire, purchasers are required in all instances to utilize all merchantable dead timber, and also inferior trees, and, as far as possible, the merchantable trees of inferior species. Trees are now commonly cut and utilized to 6 inches and even 3 inches in the tops, where formerly, in unrestricted lumbering, the limit for tops was often 12 inches or even more. Stumps are now cut to a height of from 6 to 18 inches, where formerly they were cut to 3 or 4 feet or even more. (See Pl. XXVII.) Purchasers of timber from the National Forests in the Northwest are now utilizing fully the western hemlock, which was formerly considered almost worthless. In the Rocky Mountains, Alpine fir, black fir, and blue spruce are being taken to good advantage.

PROVISIONS FOR REPRODUCTION ON CUT-OVER AREAS.

The chief aim underlying the present administration of the National Forests is the maintenance of a permanent supply of timber and the conservation of water resources. It is intended to accomplish this, not by withholding the mature timber from cutting, but by actively engaging in use of the Forest. "Through use to a greater use," is the motto of the Forest Service. The continuity of the timber supply depends largely on the way timber is cut now. The regulation of cutting is therefore the most critical and responsible task of the whole activity of the Forest Service and is at the foundation of all present forest management on the National Forests.

There are at the present time in the United States about 160 National Forests, with an area of approximately 150,000,000 acres. From the 64,000,000 acres which it is estimated are covered with about 330,000,000,000 board feet of merchantable timber, more than 1,000,000,000 board feet of timber was sold during the fiscal years 1906 and 1907 for approximately $2,500,000. Not all of this amount was actually cut, however, since contracts in many of the larger sales allow several years for the cutting and removal of the timber.

Sales are well distributed throughout the West and vary in size from a few cords of wood to many million feet, board measure. Even the large sales are not confined to any particular district. Several have been made in the lodgepole pine Forests of the Rocky Mountains. Large quantities of yellow pine are now being cut in the Forests of the Southwest, and extensive operations are being started in the Forests of California and the Northwest. Large sales, however, are the exception rather than the rule, since most purchasers from the National Forests obtain timber in small quantities either for their own use or for the community in which it is cut.

The National Forests have been under the administration of the Forest Service for less than three years, and some have not yet been organized for a full year. It is impossible, therefore, to predict the future of the cutting, except by inference, from the condition in which they stand at present.

The National Forests may be classified into four groups, according to the silvicultural problems prevailing on them. This classification does not hold for the Minnesota National Forest, where the reproduction of white and Norway pines in competition with the aggressive jack pine is the chief problem, nor for the Black Hills Forest, where beetle ravages place it in a class of its own. These groups do not, as a rule, end abruptly, but merge gradually into one another. The four classes are as follows:

(1) The Rocky Mountain group, comprising the Forests of Montana, Idaho, Wyoming, northern and central Utah, and northern

FIG. 1.—THE OLD WAY.
[That part of the felled tree shown in the picture was left in the woods to rot.]

FIG. 2.—THE NEW WAY.
[The whole tree utilized; brush piled for burning.]

METHODS OF LUMBERING.

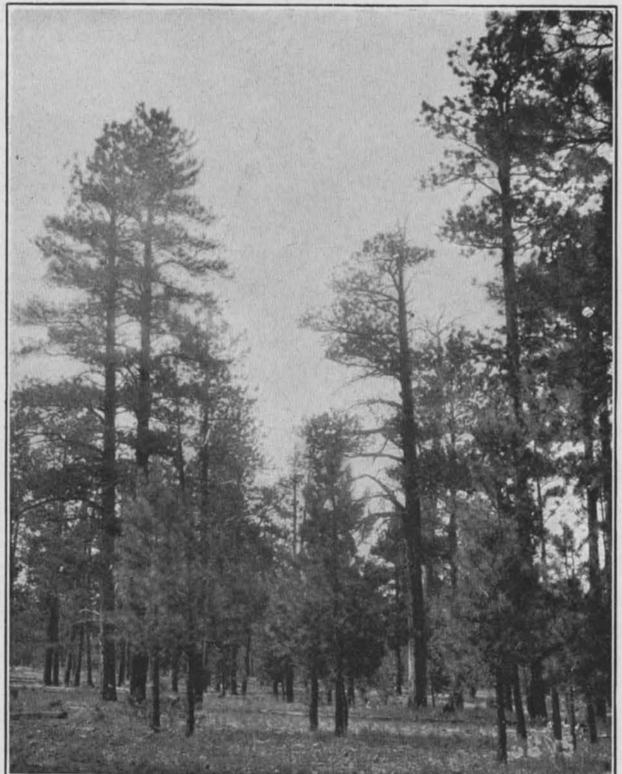

FIG. 1.—BEFORE CUTTING.

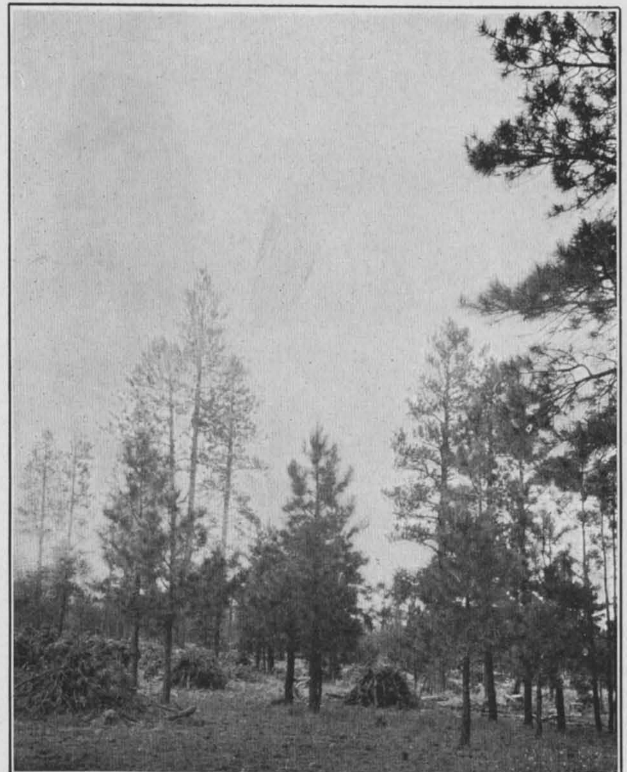

FIG. 2.—AFTER CUTTING.

LUMBERING UNDER THE SUPERVISION OF THE FOREST SERVICE.

and central Colorado. Here the main silvicultural problem is the reproduction of lodgepole pine. This group can be subdivided into two parts: (*a*) Northern, where, besides the lodgepole pine, the yellow pine, and, toward the west, the Douglas fir claim attention; (*b*) Southern, where, besides the lodgepole pine, the Engelmann spruce is an important species, with distinct problems of its own.

(2) The Cascade Mountain group, embracing the Forests of Oregon and Washington. Here the problem is the increased production of Douglas fir to supplant hemlock.

(3) The Sierra group, including the forests of northern and central California. Here the problem is how to obtain, in a mixed forest of yellow and sugar pine, white fir, and incense cedar, the reproduction of the pines to the exclusion of fir and cedar.

(4) The Southern group. This is not confined to one physiographic region, but extends over the coast mountains of southern California, the Colorado plateau, and the southern Rocky Mountains, including the Forests of southern California, Arizona, southern Utah, southern Colorado, and New Mexico. Here the main silvicultural problem is the reproduction of yellow pine, the character, rapidity of growth, and general behavior of which are practically the same throughout this group, but very different from those of the yellow pine in California and Idaho.

For each of these groups there has been worked out and adopted a definite plan of silvicultural treatment, which is usually embodied in a set of marking rules for each individual timber sale within the given group and forest type.

Thus in lodgepole pine forests, tracts in some sales are cut clean, except for groups of seed trees at regular intervals. In other sales only selected, mature, overmature, or defective trees are taken. In still others strips of seed trees are left. (Pl. XXVIII.) In most cases, lodgepole pine is severely cut, because such cuttings, when followed by burning over the ground after the branches have been lopped, result in dense reproduction. In a lodgepole pine forest there are always on the ground many unopened cones of several seed years. A surface fire opens the cones and releases the seed, which often results in enough young growth to make the leaving of seed trees almost unnecessary.

In Engelmann spruce forests, light cuttings which do not disturb the forest conditions, with careful protection from ground fire, produce the best results. The Engelmann spruce seeks moist situations; it is found at high elevations near the timber line, mostly on springy ground, and on northern slopes. If it extends to lower elevations it is only along water courses. Heavy cuttings, by letting in too much sunlight, would dry up the ground, and so prove fatal to Engelmann spruce. Light cuttings do not interfere with the reproduction of the

tree, since it is capable of coming up under shade, and there is always a good proportion of young growth in an Engelmann spruce stand.

In the Cascade group, heavy cutting, together with the retention of a few seed trees, and burning over the cutting area is practically the only way of getting a good reproduction of Douglas fir where it occurs with hemlock. Observations have proved that where Douglas fir has been lightly cut over and the ground cover unburned, it is followed by the less valuable hemlock. Hemlock is a tolerant species; it needs protection from the sun; and it requires for its generation a fairly deep leafy mulch; in other words, precisely the conditions found in a lightly cut-over Douglas fir stand. Douglas fir requires exactly the opposite conditions. It is intolerant, and comes up only in a good mineral soil. Many fine stands of second growth Douglas fir owe their reproduction to the ground fire after heavy cutting.

In the Sierra group of the National Forests, conservative cutting is the rule. Only old, mature, and decaying trees are marked for removal, while all sound and thrifty trees, which, though merchantable and mature now, will live for the next fifty years, are left. These trees are expected to produce within the next fifty years a second cut of an amount sufficient to justify logging. In the meantime they will act as seed trees and stock the ground with young trees for a third crop. Efforts are being made in these National Forests to prevent the increase of white fir and incense cedar, which are inferior trees and of little commercial value, and to favor the more valuable pines. Almost invariably the inferior species in mixed stands are cut to a much smaller diameter limit, and where they are a decided detriment to the forest, even the destruction of seedlings and young trees of these species is encouraged during the lumbering operations.

In the Southwest, the most common method is to cut to diameter limit and leave enough seed trees to insure reproduction. As a rule only thrifty, fast-growing trees are left; where there are not enough of them to reseed the ground, large mature trees are left for this purpose. The question of leaving a sufficient number of good seed trees is carefully considered in all marking, even when leaving such trees means a decided reduction in the receipts from timber sales.

MARKING TIMBER.

The importance of careful marking is now more completely understood than ever before, and is emphasized in every possible way. Whenever possible, the Forest officers best qualified, preferably technically trained men, are assigned to this work. The plan for the cutting is determined upon only after a careful study upon the ground, and reference to all available information both in the local office and in the office at Washington. This plan, however, may be changed

STRIP METHOD OF CUTTING ON NATIONAL FORESTS.

[Brush piled and ready to be burned as soon as logs are removed.]

from time to time, even during the course of the sale, if the conditions seem to demand, provided such a change is not inconsistent with the terms of the contract. Different methods of cutting are being tried with various species on a scale large enough to make the results of great practical value.

DISPOSAL OF BRUSH.

Next to marking timber and leaving seed trees, the disposal of brush resulting from lumbering has the most decided effect upon the future of the cuttings. The greatest danger from leaving the slash scattered about, or piled just as the choppers have left it, is fire. Probably 90 per cent of all cuttings on which the brush was not disposed of have been burned over, which will retard a second crop for fifty or one hundred years.

The manner of disposal, whether by scattering, ground burning, piling and burning, or piling and not burning, is dependent upon the conditions in each case. Thus, on thin soils and steep slopes at high altitudes, where the danger from fire is small, it has been found most advantageous to lop and scatter the brush to form a mulch and protect the soil from erosion. In the Northwest, in sales in which all trees except seed trees are taken, and it is desired to obtain Douglas fir reproduction, the cutting is completely burned over. In the majority of cases the brush is piled and, when there is any danger from fire, it is burned. The purchaser is usually required to pile the brush, but in most cases the burning is done by Forest officers.

As a result of the disposal of brush, the unsightly appearance so characteristic of the old-time cuttings on the public domain, where no effort was made to dispose of tops and lops, no longer exists.

PLANTING.

The high cost of forest planting and the unfavorable conditions for it throughout most of the western mountains make it necessary to depend, as a general rule, upon natural reproduction to restock the ground. There are, however, many million acres of denuded land within the National Forests which must be artificially planted in order to make them bear a forest growth. Such planting has already been inaugurated, but the area which needs to be planted is enormous, and the work now is confined chiefly to the lands which need a forest cover most, that is, to watersheds upon which cities and towns are dependent for their supply of water. The first planting of this kind was done in 1902, in the vicinity of Pasadena, Cal. Since then similar work has been done on city watersheds in Colorado, Utah, Idaho, and New Mexico. Some planting has been done also in the Black Hills National Forest, where there are large areas of cut-over and burned-over land which are entirely without seed trees and where the need for mining timber is urgent.

The planting in the sand-hill region of Nebraska must also be mentioned, although it is not connected with the reclamation of cut-over and denuded land, since the sand hills are naturally devoid of forest growth. At present about 2,000,000 seedlings have been planted on the National Forests on more than 2,000 acres. This is only a small beginning in comparison with the amount of planting that must be done. Everything connected with the work is new; there are no precedents to follow, and each phase must be worked out step by step.

The planting operations of the Forest Service are now concentrated at six large planting stations: One in southern California, one on the Dismal River National Forest in Nebraska, one on the Pikes Peak Forest in Colorado, one near Fort Bayard, N. Mex., one on the Salt Lake Forest in Utah, one at the Pocatello National Forest in Idaho, and one on the Pecos River Forest in New Mexico. At each of these stations nurseries are maintained where stock is raised for planting on the local Forest and for shipment elsewhere. The total area of these nurseries at present is nearly 14 acres, and their annual productive capacity is between 8,000,000 and 10,000,000 seedlings. Each nursery is practically an experimental forest planting station. A large variety of species are tested and various methods are tried.

In the future, when stumpage prices become higher and forest products are more completely utilized, clear cutting with subsequent planting, as is practiced in the more densely populated States of Europe, may perhaps become practicable on many of the National Forests. Planting then will be the quickest and surest method for restocking cut-over areas. Until then, however, natural reproduction will remain the cheapest and, under the circumstances, the only practicable way of securing the continuity of our forests.

CONCLUSION.

Such, in brief, are the measures by which the Forest Service hopes to provide for a future forest on the land that is now being cut over. Time alone can show whether these measures are effective or not. No doubt there will be mistakes and failures. On some cuttings reproduction will not be as dense as hoped for; on others it will not be of the kind that was expected. But, if the experience gained by long years of systematic forest management abroad and the lessons taught by the old cuttings in this country count for anything, the land cut under present provisions will not become barren waste, as most of the old cuttings have, but will be continuously producing timber of commercial value.

TRAFFIC ON CHESAPEAKE BAY AND TENNESSEE RIVER.

By Frank Andrews,
Assistant Chief, Division of Foreign Markets.

PUBLIC THOROUGHFARES.

One important difference between transportation by rail and by water lies in the control of the highway. The roadway itself is an essential part of the outfit of a railroad company. Conditions peculiar to railroad traffic seem to make it necessary for the same authority which directs the movement of trains to control the roadway. Often one railroad company uses a part of the tracks of another, but such use is regularly the result of mutual agreement.

Waterways, on the other hand, are maintained and controlled by an authority entirely distinct from that which directs the movement of the boats. The Federal Government has control of the navigable waters of the United States and prescribes regulations for their use. A navigable waterway is a public thoroughfare, as free to all persons as is a country road or a city street, and subject only to the regulations prescribed by the National Government.

Water transportation has other advantages. In some respects it is cheaper than transportation by rail, even when the cost of making and maintaining the respective thoroughfares is taken into account. But there are disadvantages as well. In some cases the moving of freight by water would be both costly and inconvenient. Improvements in certain rivers or the construction of canals over certain routes would involve expenditures greater than the resulting traffic would justify. Again, the influence of weather conditions upon navigation results in more or less irregularity of boat service. Storms, fogs, or low stages of a daily tide often delay boats, but in ordinary freight service these hindrances to navigation are not serious. Considerable injury to boat traffic may result from a period of one or more weeks during which the water is too low for navigation, and the occurrence of these low-water periods at irregular intervals throughout the year makes boat service on some rivers still less efficient. The value of waterways to commerce depends largely upon local conditions.

LOW RATES FOR BIG LOADS.

The value of inland waterways to agriculture depends upon certain factors, among which are freight rates, reliability of service, and freedom of carriers to compete for business. The first factor affects chiefly articles of large bulk and relatively small value, which, therefore, can bear only the lowest freight charges. Of this class of farm products grain is the most important. Reliability of service concerns chiefly such perishable commodities as poultry, milk, eggs, fresh fruit, and vegetables. These are of sufficient value to pay rates much higher than those charged for grain, but their nature will not permit delays in transportation. Being perishable, they must be called for regularly and delivered promptly. The third factor affecting the farmer's interest in waterways is competition. A waterway offers a thoroughfare open not only to all boatmen acting as common carriers, but also to farmers and others who carry their own goods.

Where large shipments can be obtained and the loading and unloading done at small cost transportation is much cheaper by water than by rail. Hence the movement of grain in large quantities over long water routes can be made at low cost. During the ten years ending with 1903 the average yearly rates charged by the barge lines on the Mississippi River were from 4.20 to 5.89 cents per bushel for carrying wheat from St. Louis to New Orleans, while the railroads charged from 10 to 12 cents per bushel.

The cost per ton per mile for all freight carried through the Sault Ste. Marie Canal during the ten calendar years 1896–1905 was 0.93 mill, while the receipts per ton per mile for freight on all railroads in the United States during the ten years ending June 30, 1905, averaged 7.63 mills, or more than eight times the water rate just quoted. The average cost of carrying coal in barges from Pittsburg to Memphis in 1903 was given by the Chief Engineer of the United States Army as 42 cents per ton by river and the average rate by rail was quoted as $3.73 per ton. Coal carried from Pittsburg by river is usually loaded on barges, a number of which are moved by a single towboat.

One of the largest towboats in the Mississippi Valley has taken at one time 56 coal barges and 4 "model" barges; the total freight on this tow amounting to 67,307 tons. This amount, if carried on the ocean, would require 10 or 12 of the larger freight ships. While this is an unusual size for a single tow, it illustrates what can be done when sufficient freight is concentrated at one time at points along a water route. All the barges composing a tow are not necessarily taken from the same point; on some routes barges are received and delivered by towboats at intermediate landings, as well as at

terminal points. Thus the carrying capacity of a tow may be enlarged or diminished according to the needs of the service at any one time.

PROMPTNESS OF DELIVERY.

The steamboat is a good carrier for perishable farm produce shipped over distances as great as 100 or even 200 miles. Eggs, poultry, vegetables, fruit, live stock, and other freight taken on board late one afternoon can be delivered next morning at a destination 100 miles or more distant.

In promptness of service the steamboat excels the railroad on some routes, while on others the railroad service is better. A car may require to be moved in two or more trains before it reaches its destination and delays may occur in the transfer from one train to another. Shipments in less than carload lots may be subjected to still further delay.

PRIVATE CARRIERS.

On a number of inland waterways producers use their own boats to carry goods to shipping points or to market. Sailing vessels and gasoline launches are often used for this purpose on Chesapeake Bay and its affluents. Such products as watermelons, vegetables, oysters, canned goods, and firewood are shipped to Baltimore, Washington, and Norfolk in boats owned by the owners of the freight. The carrying capacity of these vessels ranges from less than one ton to several tons. Similar conditions exist in the neighborhood of other seaboard cities. In Florida numbers of fruit growers and truck farmers along Indian River use their sailboats to carry fruit and vegetables to shipping points or to market. The same is true of farmers living near the tidal waterways in Carteret County, N. C. The products carried there include vegetables, cattle, hogs, and sheep.

On navigable rivers of the Mississippi Valley steamboat landings are usually so close together that producers generally find it more convenient to deliver relatively small quantities of freight to steamboats making regular trips than to do the transporting themselves, but large quantities of freight are often moved by the owners. A number of companies dealing in railroad ties operate their own towboats and barges on these rivers. At least one grain dealer in the Ohio Valley ships corn in his own barges and towboats.

CHESAPEAKE BAY.

STEAMBOAT ROUTES.

Conditions of transportation on Chesapeake Bay and its affluents illustrate how traffic is conducted on tidal waterways. The local trade only is to be considered here, and not through traffic of Norfolk with Baltimore and Washington or the coastwise and foreign commerce.

The local trade is that of small landings. Each navigable arm of the bay contains a group of landings, and many of these groups are connected by steamboat lines with Baltimore, Norfolk, or Washington. The principal routes out from Baltimore reach the following regions, the greater number of which are on the eastern shore of the bay. Two or more lines ply between Baltimore and landings near the head of Chesapeake Bay, while another route goes through the Chesapeake and Delaware Canal and up the Delaware River to Philadelphia. Other lines run between Baltimore and landings on the Chester River as far as Crumpton, Md.; on the Choptank River almost to the Delaware line; on the Nanticoke River as far as Seaford, Del.; on the Wicomico to Salisbury, Md., a point as far east as Seaford; on the Pocomoke River to Snow Hill, Md., not far from the Atlantic Ocean, and on a number of estuaries in Accomac and Northampton counties, Va., as far down the coast as the Occohannock River. This region is also well supplied with railroads and some of the steamboat lines are operated in connection with them.

On the western shore of Chesapeake Bay, also, steamboat lines run out from Baltimore to several different groups of landings. One line connects Baltimore with Annapolis and with wharves 10 or 20 miles south of the latter city; another boat service extends still farther south to the landings on the bay as far as the Patuxent River, and reaches points on both banks of that river as far up as Bristol, Md. Another group of landings consists of those on the lower Potomac. These are reached by lines from Washington, D. C., as well as from Baltimore. Another line out from Baltimore runs to points on the Rappahannock River as far up as Fredericksburg, Va.; and a service also extends still farther south to the Piankatank River. Unlike the eastern shore of the bay, the western shore, between the Severn and James rivers, has very limited railroad facilities, for not many of the landings reached by the western shore steamboat lines are within hauling distance of a railroad.

From Norfolk the steamboat service extends up the western shore of the bay as far as Mathews County, Va., to a region which is also reached by a line from Baltimore. Local boats from Norfolk ascend the James River as far as Richmond, somewhat over 100 miles, while a short steamboat route from Norfolk ends at Suffolk, on the Nansemond River.

WHARVES.

On account of the regularity of the tides in Chesapeake Bay it is practicable, as on all other tidal waterways, to build wharves on which are erected covered sheds for the protection of freight. Steamers thus have landing places where freight is fairly well protected from the weather convenient to boats' decks. The saving of expense made possible by the use of wharves is due partly to the saving of

time in transferring freight and partly to the protection of the freight from injury by the weather.

One disadvantage in regard to landing experienced by tide-water steamboats as compared with boats on western rivers is the necessity for these wharves. A landing made by a tide-water boat must be at a wharf. On rivers of the Mississippi Valley, as will be mentioned later, landings accessible to steamboats are provided by nature, and wharves are unnecessary. The draft of river steamers in the valley is usually somewhat less than that of tide-water steamboats and the hulls of the two classes of vessels are of different shapes.

LARGE WHEAT MOVEMENT.

The northern part of the peninsula east of Chesapeake Bay, embraced largely in the Maryland counties of Cecil, Kent, and Queen Anne, supplies large quantities of wheat for neighboring markets. This grain is moved to Baltimore by steamboats, sailing vessels, and power barges. In fact, so great is the demand for water transportation of this crop that almost all kinds of boats are pressed into service. On July 25, 1907, no less than 52 sailing vessels, power barges, and other small craft arrived in Baltimore Harbor with cargoes of wheat from points on Chesapeake Bay and its affluents. Sailing vessels carry grain in bulk. It is hauled to the wharves in sacks and emptied into the holds of vessels. Small boats can reach landings inaccessible to steamboats and thus can save farmers in many cases numbers of miles of hauling.

The rates charged by these sailing vessels, governed largely by demand and supply, range from 2 to 4 cents per bushel of wheat from eastern shore landings to Baltimore elevators. A large number of vessels which, at other seasons, are engaged in oyster traffic, are employed by grain shippers during the summer months. The importance to Baltimore's grain trade of this water transportation may be judged from the receipts of wheat at Baltimore during the twelve months ending June, 1907. In July, 1906, the receipts of wheat by water were 62 per cent of the total; in August, 26 per cent; in September, 32; in October, 23; in November, 32; in December, 22; in January, 1907, 8 per cent; in February, 2; in March, 8; in April, 23; in May, 18, and in June 35 per cent. During the entire twelve months ending June 30, 1907, 32 per cent of all the wheat received, or more than 2,000,000 bushels out of about 6,500,000, was carried in boats.

Steamboats carrying wheat give quicker service than do sailing vessels, both in the transit between loading point and elevator and in the transfer of the grain to the elevator. The steamboats having a regular schedule need to be unloaded promptly and are given preference over the sailing vessels at Baltimore elevators. The steamboats,

however, carry grain in sacks only. The rates on wheat charged by steamboats are reported to be higher than those charged by sailing vessels.

From the western shore of the bay, also, wheat is sent to Baltimore in sailboats. The first receipts from the wheat crop of 1907 came from Lancaster County, Va., and reached Baltimore July 3, 1907.

COMPETITION IN CANNED-GOODS TRADE.

Just south of the wheat region described, in the Maryland counties of Talbot, Caroline, Dorchester, and Wicomico, wheat is also produced, but a more prominent feature of agriculture is truck farming. Fresh fruits and vegetables raised in this region are carried to Baltimore by steamboats rather than by sailing vessels, especially for the longer distances. This region, as well as others on both shores of the bay, is noted for canning factories, and shipments of canned goods to Baltimore constitute an important item of Chesapeake Bay freight. As this merchandise is not perishable it is carried by schooners and other sail craft, as well as by steamboats. Each class of carriers has advantages to offer; the steamboats give quicker and more regular service, while their freight rates are apt to be higher than those charged by sailing vessels. Canners along the bay not only have the advantage of two classes of public carriers, but sometimes find it profitable to transport their products in their own schooners.

SWEET POTATO TRAFFIC.

South of this middle region of the peninsula, in the counties of Somerset and Worcester, in Maryland, and in Accomac and Northampton, in Virginia, potatoes are produced in large quantities. In the summer white potatoes constitute a large part of both rail and water freight from this section. By the middle of September sweet potatoes from this region are in process of shipment. The rate charged for potatoes from this region to Baltimore by the steamboats in 1907 was quoted by a steamboat agent as 20 cents per barrel. One boat which makes a round trip between Baltimore and lower landings on the eastern shore of Virginia twice each week has a capacity of 3,500 barrels each trip, or 7,000 barrels per week. The freight on this amount would equal $1,400 a week. This income is increased by the freight carried to this region from Baltimore. It may be said, however, that while the vessel is often loaded to its utmost capacity during the potato season there are periods when freight is not so plentiful, so the income during the busy season helps to offset the smallness of the earnings at other times.

The sweet potato shipping season lasts practically all fall and winter. The Eastern Shore of Virginia Produce Exchange regulates its shipments of sweet potatoes according to the condition of

the market, and while large quantities are sent from landings in Accomac and Northampton counties in the fall reserves are still held in the frost-proof storehouses to be taken to Baltimore during the winter and spring.

In some seasons the steamboat lines operating between Baltimore and the sweet potato region of the eastern shore have not been able to move promptly all the freight offered for shipment. A single wharf will often furnish 1,000 barrels at a time. To meet this heavy traffic in the fall of 1907 three extra steamboats were put in service.

SMALL CRAFT IN FREIGHT SERVICE.

Small boats propelled by gasoline power are in common use on Chesapeake Bay and its affluents, and a number of these vessels perform freight service both as carriers and as towboats. A gasoline launch can tow a scow holding several times as much freight as the launch itself. By this means tomatoes are carried to canning houses along such streams as the Wicomico and the Occohannock. Scows holding from 150 to 300 baskets of tomatoes each can be towed by skiffs equipped with gasoline engines. Other freight and also passengers are carried in these gasoline boats. On the Wicomico River in the fall of 1907 there were at least 5 launches in passenger and freight service between Salisbury and landings on the river below. These launches are sometimes used to carry strawberries from lower landings to Salisbury, thence to be shipped by rail to northern markets.

In connection with the increase in the number of gasoline launches in freight service the application of gasoline power to small sailing vessels is deserving of notice. The saving of time by the use of a small and relatively cheap gasoline engine is very great. The increased speed is much greater than the original average speed of the sailing boat. For use in carrying produce to market for distances of about 40 or 50 miles these boats are well adapted.

It is a common practice on affluents of Chesapeake Bay to use sail and row boats for concentrating freight at the various steamboat wharves. In the sweet potato region small sailing vessels carrying from 25 to 30 barrels of potatoes and rowboats and canoes holding one-fourth to one-half that quantity are in general use.

THE MISSISSIPPI VALLEY.

CHANGES IN STEAMBOAT TRAFFIC.

According to census returns 21,000,000 tons of freight were moved on rivers of the Mississippi Valley in 1906, 28,000,000 tons in 1889, and 7,000,000 tons in 1880. The growth of barge traffic and its application to the coal and lumber trade caused the large increase of

river tonnage in 1889 as compared with 1880, and the continued use of this means of transportation prevented the tonnage of 1906 from showing much decline under the census figures for 1889. In regard to the freight carried by steamboats in this valley there has been a marked decline. These vessels carried 9,200,000 tons in 1889, while in 1906 they carried less than one-third as much.

According to census returns the number of steamboats on these rivers was about the same in 1889 as in 1880; in 1906 the number had increased more than 25 per cent over 1889. But, according to census returns, the average steamboat in 1906 measured nearly 80 tons less than in 1889 and was about one-half as large as in 1880; the average gross tonnage in 1880 was 210; in 1889, 189 tons, and in 1906 it was 110 tons. Reports of the United States Commissioner of Navigation show that on rivers of the Mississippi Valley in 1876 there were about 176 steamboats of more than 500 gross tons each, in 1896 there were 70 such boats, and in 1906 only 50.

RIVER TRADE AT ST. LOUIS.

One of the leading inland ports of the Mississippi Valley is St. Louis. Conditions there will serve to illustrate those at a number of other river cities. According to reports of the St. Louis Merchants' Exchange the average number of steamboats arriving at that city annually during the years 1882–1886 was 2,158; in 1902–1906 the average was 1,212. The number of barges arriving declined from an annual average of 1,159 in 1882–1886 to only 437 in 1902–1906. The tons of freight received at St. Louis during the years 1882–1886 averaged 600,000 per year; twenty years later the average was 326,000 tons. Shipments by river from St. Louis declined much more rapidly; in 1902–1906 the yearly average was 138,000 tons, as compared with 612,000 tons twenty years earlier.

Through lines of steamboats from St. Louis to New Orleans are no longer in operation. At present (1907) in traveling from New Orleans to St. Louis by water it is necessary for a passenger to change boats at least twice—once, perhaps, at Vicksburg, and again at Memphis. The last line operating through packet boats over this route went out of existence about 1897. After this packet line stopped running freight traffic on the Mississippi between St. Louis and New Orleans was left to barges and towboats. The leading farm product carried from St. Louis by these barges was grain. This traffic ended a few years later and the barge lines stopped running.

ROUTES OF PACKET BOATS.

The discontinuance of through service between St. Louis and New Orleans should not be taken to indicate that long-distance water transportation on the Mississippi and its tributaries is not suitable to

present conditions. The traffic in coal and lumber still follows long routes. Large quantities of coal are carried on barges down the Ohio and Mississippi rivers from Pittsburg to New Orleans, a distance of nearly 2,000 miles.

Farm products carried on the Mississippi and its tributaries are usually moved by packet boats which also carry passengers. Among the longest routes of packet boats in the Mississippi Valley are the following: From St. Louis one line runs to Memphis, about 430 miles distant; another goes up the Mississippi 729 miles to St. Paul, and a third line from St. Louis serves landings on the Mississippi, Ohio, and Tennessee rivers as far as Waterloo, Ala., more than 470 miles distant from St. Louis. Cincinnati is connected with Pittsburg by a regular packet service, three boats per week running the 467 miles between the cities. Perhaps the longest packet route in the valley is that between Cincinnati and Memphis, 731 miles. One boat a week leaves each terminus of this route during seasons of good navigation.

Other important packet lines have their termini in Memphis, New Orleans, Louisville, Paducah, Nashville, Vicksburg, and Baton Rouge.

THE TENNESSEE RIVER.

THREE DIVISIONS.—On account of the extent and variety of its traffic the Tennessee River serves well as an example of a navigable waterway in the Mississippi Valley. The Tennessee is formed by the junction of the French Broad and Holston rivers and is navigable throughout the 652 miles of its course. With its tributaries this river affords steamboats 1,300 miles of navigation, rafts and flatboats 2,400 miles.

The river is divided by natural obstructions across the channel into three divisions. These obstructions are not altogether injurious to navigation, for they serve as natural dams, holding back some of the water above them and thus making part of the channel deeper than it would otherwise be.

The first of these obstructions is at Colbert Shoals, about 226 miles above the mouth. A second natural dam of importance is Hales Bar, where the river passes through the mountains, about 33 miles below Chattanooga. The middle division of the river contains a number of other obstructions, but the two just mentioned form the chief natural divisions of the stream. The commercial divisions correspond closely with the natural ones. Lower river traffic ends at Waterloo, Ala., and up-river boats make Chattanooga their lower terminus.

FARM PRODUCTS CARRIED ON THE TENNESSEE.—Agriculturally the lower river is divided into three sections, the division points being Danville, Tenn., about 90 miles above the mouth, and Clifton, Tenn.,

90 miles above Danville. The three sections bordering the lower river produce corn and, to some extent, live stock. In addition to these products the first section yields, possibly, more tobacco than any other special crop, the second section yields peanuts, and the third produces cotton. Very little of the tobacco raised in the lower region is sent down the Tennessee River. Peanuts, however, are regularly brought downstream to Paducah and other points. Cotton generally moves upstream to compresses at Tuscumbia, Ala., and other places.

Above Chattanooga the river flows, with scarcely an obstruction, through the East Tennessee Valley. This is an agricultural region and furnishes the steamboats with considerable traffic in grain, hay, and live stock.

NAVIGATION ON TRIBUTARIES.—Knoxville, the head of navigation on the Tennessee River, is the lower terminus of steamboat service on several of this river's tributaries. Among these are the French Broad, Clinch, Hiwassee, Little Pigeon, Holston, and Little Tennessee. The Holston River is navigable by steamboats only at unusually high water, while the French Broad affords a channel for steamboats for about 70 miles to points above Dandridge, Tenn. The French Broad with one of its tributaries, the Little Pigeon, affords a water highway for products from Sevier County, Tenn. This thoroughfare is especially valuable, since this county has no railroad. The Hiwassee River is navigable at least as far as Charleston, Tenn. The Clinch River and one or more of its tributaries also are navigable during some seasons. The total length of navigable waterways above Chattanooga on the Tennessee and its tributaries has been given by steamboat men as above 500 miles. Of this distance 188 miles are on the Tennessee itself.

STEAMBOAT SERVICE.—The packet service on the lower division of the Tennessee in 1907 was in the hands of two companies which operated four lines of boats, consisting of seven or eight packets and a number of barges. The longest route was between St. Louis, Mo., and Waterloo, Ala. A boat left each terminus about once every four days. Another line operated between Paducah, Ky., and Waterloo, each boat making one round trip per week. There were two boats continually running on this line. A third service consisted of a mail packet operating between Danville and Savannah, in Tennessee, and making two round trips per week. A fourth line connected Chattanooga with river landings as far as Joppa, Ill., on the Ohio River.

A boat between Paducah and Waterloo may possibly make 200 landings within three days. As a rule, however, some of them, perhaps half, are missed. This large number of landings necessarily increases the time required to make a round trip and hence adds to

the cost of operating boats. Since the products carried over this route are not usually of a perishable nature no damage results to freight by reason of the time required to make the trip.

Above Waterloo a number of steamboat lines connect local points. One packet boat with a barge plies between Florence, Ala., and Riverton, Ala.; another service connects Chattanooga, Tenn., with Decatur, Ala.

From Chattanooga steamboat lines up the Tennessee usually run no farther than Kingston, at the mouth of the Clinch River, while boats from Knoxville serve the landings above this point. At Knoxville in October, 1907, there were 4 packet boats in regular freight service, and 2 other steamboats were used for towing sand and stone barges.

Throughout the whole Mississippi Valley it is a common practice for steamboats to take with them barges or lighters, in order to distribute the weight of the cargo over a greater surface and thus not require such deep water for navigation. These lighters are found of especial value on the middle and upper divisions of the Tennessee and on its tributaries, where the steamboats are smaller and the water not so deep.

Freight rates.—The average rate received for freight by packet boats on the lower Tennessee River was estimated by a steamboat man in October, 1907, as $3 per ton of 2,000 pounds. The same figure was given by a steamboat manager at New Orleans, several months before, as the average rate on the lower Mississippi, and $5 per ton was his estimate for the average freight rate on the lower tributaries of that river. The freight charge on wheat to Chattanooga from points on the Tennessee River as far up as the mouth of the Clinch and as far down as Decatur, Ala., was in 1907 about 3½ cents per bushel by water. To Knoxville from upper landings, including those on French Broad River as far up as Dandridge, the rate on corn and wheat per 2-bushel bag was 6½ cents. The corresponding rail rate on wheat for a similar distance to Knoxville was given by a grain merchant as 4½ cents per bushel, amounting to 9 cents per bag, an excess of 2½ cents per bag, or 1¼ cents per bushel, over the river rate. It should be remembered that the rates just quoted for the upper Tennessee include payment for the loss of time due to the uncertainty of navigation and for the loss of such regular traffic as boats would have if able to give regular service.

The income which might result from the establishment of a regular service may be roughly estimated from the rate charged for the transportation of produce. From points along the river within hauling distance of Knoxville vegetables, fruit, eggs, and poultry are regularly carried in wagons, but if a regular boat service were

established, such produce, even from points 80 or 100 miles away, could be promptly delivered in Knoxville. To facilitate loading and unloading barges could be used. Two could be left at each terminal while two were taken by each steamer. The trip to Knoxville from the head of navigation on the French Broad River would probably require twelve or fifteen hours. The capacity of these boats for carrying produce may be judged by a comparison. One of the steamboats now operating over this route has a gross tonnage of 86 and carries about 2,000 sacks of corn, while each barge taken in tow carries from 1,200 to 1,800 sacks or similar packages. So, at a rough estimate, 5,000 packages consisting of cases of eggs, coops of chickens, or barrels of produce could be carried on a trip.

The charge for transportation under present conditions from the head of navigation on the French Broad River to Knoxville is 25 cents per coop of chickens, from 6 to 8 cents per case of eggs, and 4 cents per bushel of potatoes or apples. At an average charge of 10 cents per package 5,000 packages would thus bring an income of $500 per trip or, at an average of 6 cents per package, a full cargo would yield $300, and the freight carried upstream would constitute an additional source of income.

It must be borne in mind, however, that the estimates just given of the earning power of a boat apply only to those trips when full loads are carried. The figures serve to show possible earnings during a prosperous season and will serve as a basis for estimating roughly an average income, but they are not intended to express, even approximately, the actual earnings of steamboats now on the upper Tennessee.

Expenses of operation.—The items in the expense account of a steamboat include, among other things, wages, fuel, food supplies, and repairs. To these may be added charges for the use of wharf boats. An allowance should be made for depreciation in the value of the boat, and the owners expect a fair interest on their investment.

Wages of deck hands constitute an important part of the cost of operating a boat. On the Tennessee, as well as on other streams in the Mississippi Valley, freight is usually transferred by manual labor. Belt conveyors are seldom, if ever, used. The quantity of labor required on these rivers for handling freight is increased by the absence of wharf boats at all but the most important landings. On the lower division of the Tennessee River in the fall of 1907 deck hands were paid at the rate of $40 per month and, in addition, were given sleeping quarters and four meals a day. The expenses of operating steamboats engaged even in the same traffic vary considerably. One steamer of nearly 200 tons gross measurement paid, so

her captain reported, $1,050 for the expenses of one round trip requiring a week. On this boat the wages paid deck hands for the week's trip were probably from $300 to $400. To this amount were added the salaries of about 20 or 30 officers and other employees. The passenger service of the boat required the list of employees to be larger than if freight alone were carried.

The captain of a smaller steamboat also operating on the lower Tennessee reported his running expenses as $75 per day, or $525 per week, just one-half the expenses of the larger boat. But since the route of the smaller boat was different from that of the larger one and required twelve days instead of one week, the expenses of this round trip at $75 per day would be $900. The carrying capacity of the larger boat without barges was about 375 tons; of the smaller boat about 300 tons. At the average rate of $3 per ton, estimated by one of the Tennessee River captains, the freight earnings from a full load for a trip in one direction only would be about $1,100 for the larger boat and $900 for the smaller one, or, in each instance, not far from the operating expenses for the entire round trip. With such large earnings from freight carried in one direction the receipts from freight on the return trip and from passengers would be clear profit.

Above Chattanooga and in the local service between that city and Decatur, Ala., the running expenses of a steamboat have been given as $25 to $60 per day, the cost of a round trip ranging from $75 to $360, according to the time required and the kind of boat used.

For purposes of comparing, it may be of interest to note that the running expenses of Mississippi Valley steamboats of about 500 gross tons, according to the superintendent of one of the large packet lines, average $2,000 per month, and that boats on the Mississippi River south of Cairo pay much more than this during the cotton season. Steamboat managers at Memphis and New Orleans said in January, 1907, that they were paying deck hands or "roustabouts" at the rate of $90 per month and board.

Cost of building boats.—The cost of Tennessee River steamers varies, of course, with the size and the kind of equipment of each boat; for service on the tributaries above Knoxville, steamboats have been built at a cost of $5,000 to $6,000, while steamers twice as large in use below Chattanooga are said to have cost from $20,000 to $25,000. Census returns show that the average cost of 26 steamboats built in the Mississippi Valley in 1904 was $15,500 each, while the average cost of each of 570 canal boats and barges built in the same year on the same rivers was $800.

The value of a certain Tennessee River barge at prices prevailing in 1907, according to the owner, was $600. This boat carried 1,800

bags of corn and, as the freight on each bag was quoted as $6\frac{1}{2}$ cents, a full load of corn carried the usual distance, about 50 or 60 miles, would earn $117, and five such loads would earn almost enough to pay for the barge.

It should be noted again that these estimates of the earning power are based upon maximum loads. They serve to show possible advantages of water transportation under favorable conditions, and must not be understood as referring to actual conditions as they existed in 1907.

Wharf boats and natural landings.—On the Tennessee River, as on the other streams of the Mississippi Valley, wharves would be of little use. The various stages of the river would at times place them either too high or would cover them completely. Even at Knoxville, almost at the head of the Tennessee, the difference between high and low water mark is about 40 feet. As the river increases in size farther down the stream, the range of water levels also increases. Wharf boats are, therefore, used instead of stationary wharves, but are placed at only a few of the more important landings. A wharf boat is simply a covered floating wharf that rises and falls with the river. A stage or gang plank serves as a bridge over which wagons and drays can be driven to deliver or receive freight.

At Paducah the wharf boat company charges each steamboat line a certain sum per trip or per month, according to the terms of the respective agreements. For a single landing the charge fixed in October, 1907, was $2, while some boats having a monthly contract paid a lower rate. In addition to the income from steamers the wharf boat company collects charges on incoming freight. No charge is made on outgoing freight. The general rate of wharfage at Paducah on incoming freight was 50 cents per ton. Some articles pay special rates. The wharfage on hay was 20 cents per ton, or about one-fifth of the steamboat rate on that product to Paducah from other landings on the lower Ohio.

Another convenient arrangement for loading and unloading steamboat freight is an inclined railway, one of which is in use at Riverton, Ala. Here two tracks are laid on the steep bank from the railroad freight station down into the river. Two cars are operated up and down this incline by means of cables and a stationary engine. The cars are let down until their floors are about level with the guards of the steamboat; the freight is transferred to the cars directly from the deck of the boat, and the cars are then drawn up until their floors are level with the platform of the railroad freight station, where the goods are unloaded.

The use of wharf boats on the Tennessee is exceptional. All but a very few points on the Tennessee, as on other rivers of the Mississippi

Valley, are without any more facilities for landing or loading freight than are afforded by the nature of the river bank. Hand trucks are not always easy to manage at such landings, and usually the freight has to be carried instead of wheeled. In wet weather the time for loading or unloading a given quantity of freight is increased on account of the slippery banks.

CONCLUSION.

ADVANTAGES AND NEEDS OF RIVER TRAFFIC.

Transportation, as now effected on Chesapeake Bay and the Tennessee River, shows, to some degree, the advantages and the needs of the inland waterways of this country. These two systems afford a number of examples of efficient and economical methods of carrying freight. Among the more striking conditions of water traffic are the development of towboat service, the possibility of improvement in the methods of loading and unloading freight carried by steamboats, and the need of longer and more regular seasons of navigation.

Towing is necessarily a slow method of transportation, the speed of the towboat being reduced with each additional barge taken, but this disadvantage is offset, so far as a large class of freight is concerned, by the relatively low cost of service, the enormous carrying capacity of a tow, and the facility with which the number of barges composing it may be changed. Towboat service is fairly well developed in the United States, both on rivers of the Mississippi Valley and on inland waterways along the seacoast, and as new water routes are opened for use this method of transportation will be ready to take advantage of them.

Methods of loading and unloading freight, however, are susceptible of considerable improvement, especially in local steamboat traffic. The substitution of machinery for manual labor has not taken place to a considerable extent at any but the more important landings on inland waterways. The fact that the smaller landings and wharves are not usually owned by the steamboat companies using them may have contributed to the delay in providing labor-saving devices for the transfer of freight. With the growth of traffic, no doubt, improvements in this line will be made.

IMPORTANCE OF BETTER CHANNELS.

One of the greatest hindrances to the growth of river traffic in the Mississippi Valley has been and is low water. The low-water seasons do not come at regular intervals and are not uniform in length. The uncertainty of river service has been one of the influences diverting to railroads all but a very small fraction of the carrying trade of the valley.

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Some of the rivers of this region are more favored than others in regard to navigable water, but even the Mississippi itself sometimes fails to give free passage to traffic. One barge fleet in the grain service about 1900 or 1901 is said to have consumed nearly two months in making the round trip between St. Louis and New Orleans. The regular time was about one week. Regularity of navigation on the Mississippi and its large tributaries for towboats and barges such as were used a few years ago between St. Louis and New Orleans would add greatly to the transportation facilities of the Central States. Even a larger load could be carried on a tow on these streams than is now carried by one of the largest freight steamers on the Great Lakes. Many smaller streams of the valley could be made highways for the regular movement of farm produce and other freight if the channels were kept navigable throughout most of the year. The interruption in winter on account of ice occurring each year at about the same season would not be a serious drawback. Irregularity of seasons of navigation is and has been one of the most serious obstacles to water transportation on these rivers.

Where navigation is regular, as on the Great Lakes and a number of tidal waterways along the seacoasts of the United States, boat traffic has continued to grow in spite of increased railroad facilities. But on our greatest river system, with its thousands of miles of steamboat routes, conditions are in striking contrast with the marvelous development in other phases of commercial life.

It is to be understood that in some instances improvements of river channels are costly and some work is done only to be destroyed by the next flood. This is not true of all such work, by any means. The great amount of service already rendered to freight traffic on inland waterways by wise improvements has much of promise for the future.

PROMISING NEW FRUITS.

By Wm. A. Taylor,

Pomologist in Charge of Field Investigations, Bureau of Plant Industry.

INTRODUCTION.

For many years there has been a strong tendency in the American fruit trade to urge that fruit growers reduce the number of varieties in their commercial plantations. When commercial fruit growing was developing out of the old-time family orchard, with its succession of varieties ripening throughout the season, such advice was undoubtedly good for the average individual planter, but there appears good ground for the belief that a point has been reached in several of our orchard fruits where a wider range of season and quality would result in a steadier net income from the fruit crop, and therefore in a sounder business condition in the fruit industry in many sections. Attractive diversity in appearance and quality stimulates a demand for fruit among consumers and is worthy of recognition by the fruit grower as an important factor in determining his selection of varieties for planting. If he has several varieties in his orchard rather than a single one or two, the advantages of cross pollination are secured also, and the risk of loss of crop through unfavorable weather at the blossoming season is reduced.

The varying requirements of our domestic and foreign markets and the importance of growing in each section of the country those varieties that are best adapted to the climatic and cultural conditions there, render familiarity with new types and varieties important to all progressive fruit growers.

The present article, in connection with those that have preceded it on the same subject in the Yearbook since 1901, calls attention to several recently introduced or little-known fruits that are considered worthy of testing in various sections of the country.

DELICIOUS APPLE.

[PLATE XXIX.]

This variety first came to notice in the orchard of the late Jesse Hiatt, of Peru, Madison County, Iowa, about 1881. It was then a sprout, supposed to be about 6 years old, from the stock of a Yellow Bellflower tree, the top of which had been destroyed. The beauty and

fine quality of the fruit attracted Mr. Hiatt's attention and he at once began its propagation in a small way for his own planting. The tree proved to be a hardy, vigorous, upright grower, with very heavy, dark-green foliage, and a regular annual bearer. At 15 years of age the original sprout was reported to be 13 inches in diameter at the ground. The originator stated in 1896 that while three-fifths of his orchard had been destroyed by drought and cold during the preceding eight years, "Delicious" had not been injured in any respect. The name "Hawkeye" was at one time applied to the variety by the Hiatt family and locally used, but does not appear to have been published in connection with it and is therefore not entitled to recognition as a synonym.

The right to propagate and sell the variety for a term of five years having been sold to the Stark Brothers Nurseries and Orchards Company about 1894, with the right to rename the variety,[a] it was commercially introduced by that firm in 1895 under the name "Delicious," which word was registered in the United States Patent Office as a trade-mark July 4, 1905.

DESCRIPTION.

Form roundish conic, sometimes indistinctly ribbed and knobbed at apex; size medium to large; surface smooth, glossy, taking a high polish when rubbed slightly; color clear, translucent, pale yellow, washed over most of the surface with mixed red, striped and splashed with dark crimson, and in dry climates covered with a thin whitish bloom; dots numerous, small yellow; cavity regular, of medium size, deep, russeted; stem medium to long, stout, curved, downy; basin regular, of medium size, depth, and slope, slightly furrowed and somewhat downy; calyx segments medium, converging, eye of medium size, closed; skin moderately thick, tenacious; core of medium size, oval, clasping, open; seeds numerous, plump, medium, brown; flesh yellowish, moderately fine grained, breaking, juicy; flavor mild subacid, quality very good. Season December to March, in Madison County, Iowa.

Though lacking such marked and distinctive quality as characterizes our best apples, such as Esopus, Jonathan, Northern Spy, Grimes, and Yellow Newtown, this variety is acceptable to most palates and is apparently entitled to high rank as a dessert fruit. The tree is a strong, upright grower, apparently sufficiently productive to satisfy commercial requirements. In the locality of its origin it is apparently rather susceptible to apple scab and will therefore need to be thoroughly sprayed for that disease in cool and humid climates. It has been fruited on young trees during the past four or five years in most of the apple districts west of the Mississippi River and appears to be

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[a] Letter of S. L. Hiatt, Peru, Iowa, November 7, 1905.

specially promising in the Rocky Mountain and Pacific coast States. The specimen illustrated in Plate XXIX was grown by Mr. S. L. Hiatt, Peru, Madison County, Iowa.

ENSEE APPLE.

[PLATE XXX.]

This promising new sort originated about 1880 as a chance seedling near a place where cider had been made in earlier years on the farm of the late Nelson Cox, in Windsor Township, Lawrence County, Ohio. Little notice was taken of it for several years after it began bearing, until 1895, when its crop began to attract attention. Since then it has been somewhat disseminated in an experimental way, and commercially to a slight extent by the sons of Mr. Cox.

The tree is described as rather upright and spreading in habit, with rather pale bark. It blossoms just after Ben Davis and is considered a productive and regular bearer.

The coined name "Ensee" was applied to the variety about 1898 in perpetuation of the apple brand (N. C.) of the originator, who was for many years recognized as one of the leading commercial apple growers of his region.

DESCRIPTION.

Form roundish to roundish oblate; size large; surface rather smooth, undulating; color pale yellow washed with mixed red, splashed and brokenly striped with bright crimson, frequently overspread with gray; dots variable, some russeted and aureole, many of those near the apex being indented; cavity irregular, large, deep, abrupt, russeted, and sometimes lipped; stem short, moderately stout; basin deep, abrupt, furrowed, downy; calyx segments small, converging, reflexed at tip; eye small, nearly closed; skin thick, tenacious; core of medium size, roundish, clasping, open; seeds numerous, of medium size, plump; flavor subacid, rich; quality very good. Season late autumn and early winter in Lawrence County, Ohio, keeping well in cold storage. This variety is apparently deserving of test throughout the Middle States and the irrigated valleys of the West, as it is an apple of large size and fine quality, adapted to home use and special markets. The specimen illustrated on Plate XXX was grown by Cox Brothers, Rockwood, Lawrence County, Ohio.

LAMBERT CHERRY.

[PLATE XXXI.]

The large size and fine color of the sweet cherries grown in the Willamette and Columbia river valleys in Oregon have for many years attracted the attention of cherry growers and users to those sections,

which seem peculiarly adapted to the production of this fruit. Fortunately for the reputation of the Willamette Valley, the earliest introduction of cherries there (in 1848 by Henderson Lewelling, at Milwaukee, Oreg.) appears to have included some of the choicest varieties, so that the planters of that district were not compelled to go through the long and trying experience with seedlings of indifferent quality that is common in newly settled regions. At the same time some very promising seedlings from these older sorts have in recent years come to light, some of which, such as Republican, Bing, and Hoskins, have attained considerable commercial importance.

One of the most promising of these new sorts is the Lambert. This variety appears to have originated[a] as a seedling under a Napoleon (syn. *Royal Ann*) tree in the orchard now owned by Mr. J. H. Lambert, at Milwaukee, Oreg., which was planted by the late Henderson Lewelling during and shortly after 1848. This seedling tree, which is supposed to have been a cross of Black Heart on Napoleon, was grafted to May Duke before it reached bearing age and transplanted to a location at one end of the old orchard. About 1880 the May Duke top was broken off or died, and a sprout from the seedling stock was permitted to form a new top to the tree. When it came into bearing its fruit attracted Mr. Lambert's attention, and shortly after 1890 small shipments of it sent to Boston and other eastern markets sold at much higher prices than other varieties shipped at the same time.

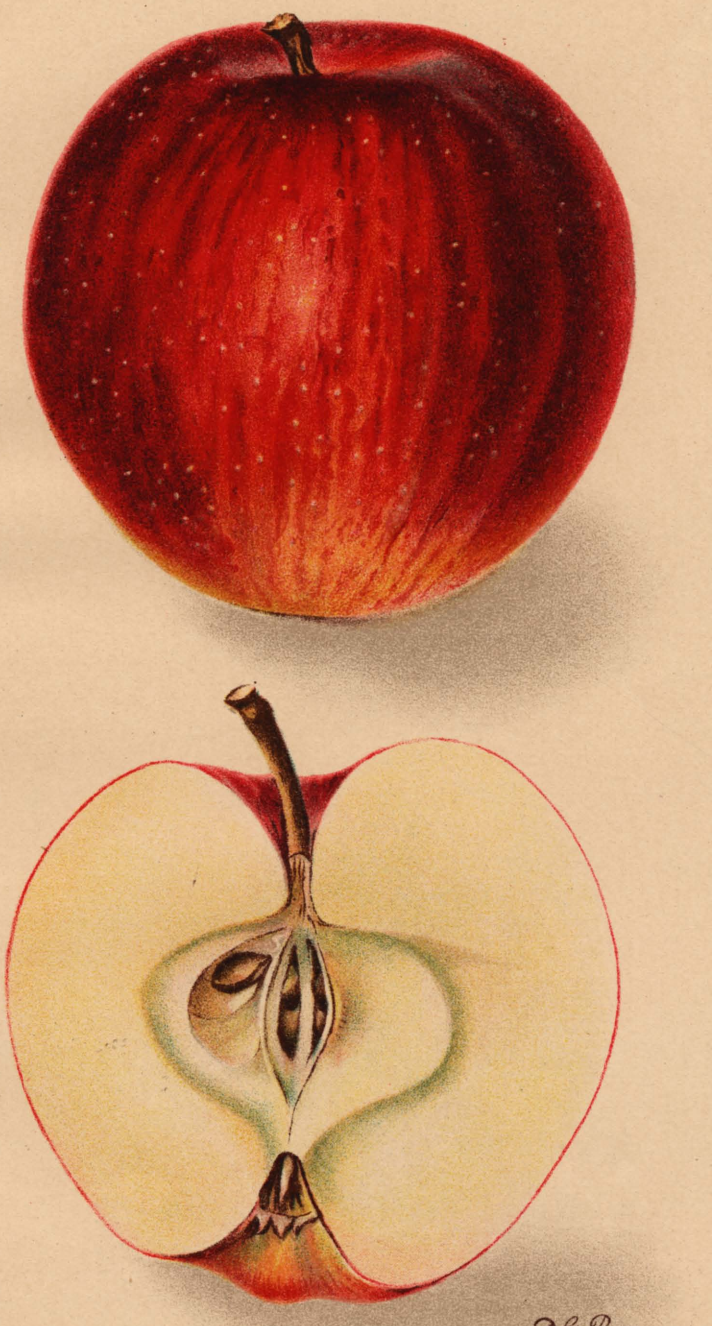
In 1895 Mr. Lambert gave to the Oregon State Horticultural Society the exclusive right to propagate and disseminate the variety from the original tree and a few trees that he had grown from it, but scions having been previously secured by other persons without his knowledge, the society derived little financial benefit from its introduction.

So far as known, it has not been extensively planted east of the Rocky Mountains, but it is considered worthy of testing wherever sweet cherries thrive.

DESCRIPTION.

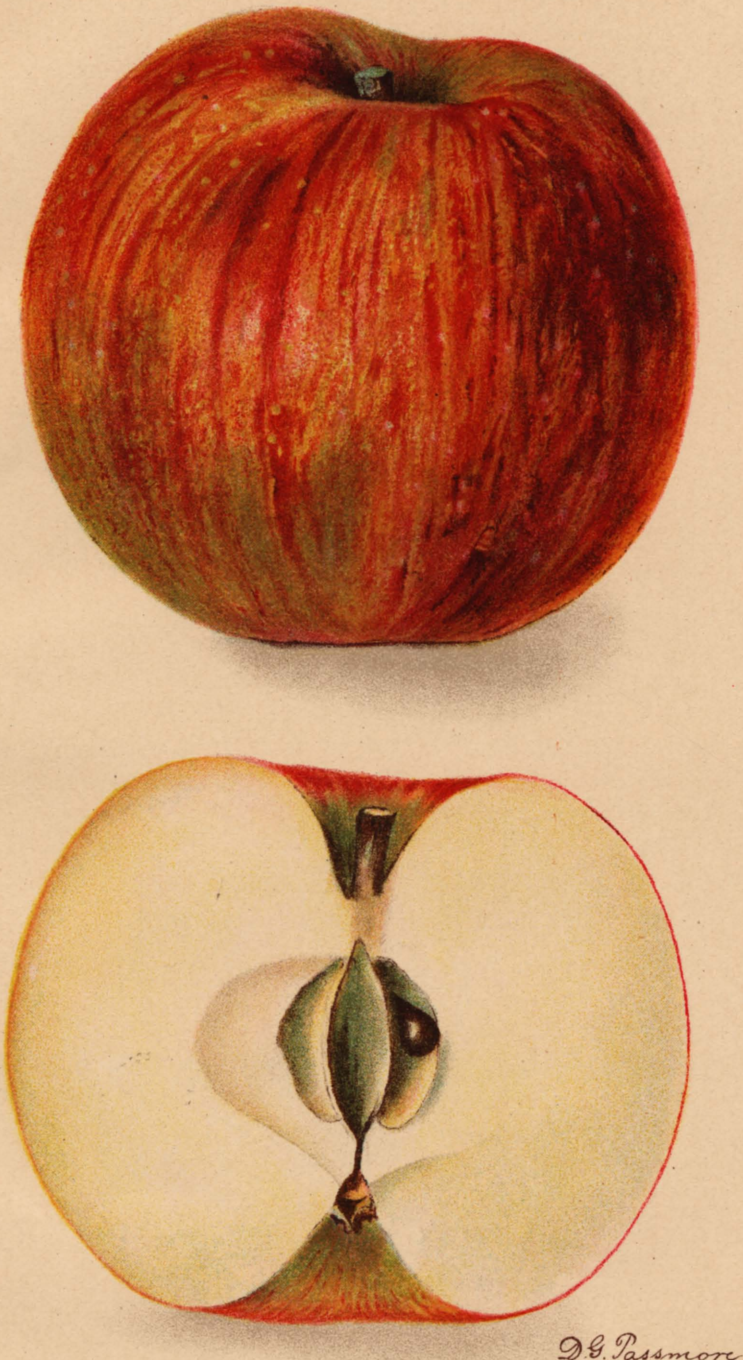
Form oblong, heart-shaped; size large to very large; cavity of medium size and depth, with gradual slope; stem medium to long, rather slender; suture a mere line, terminating in a russet dot in a slight depression at the apex; surface smooth, except for numerous fine indented dots; color light red, beautifully marbled with darker red; skin moderately thick, tenacious; stone oval, rather large, adhering rather closely to flesh; flesh purplish red, with lighter mar-

[a] Letters of E. L. Smith, Hood River, Oreg., and H. M. Williamson, Portland, Oreg., August, 1907.



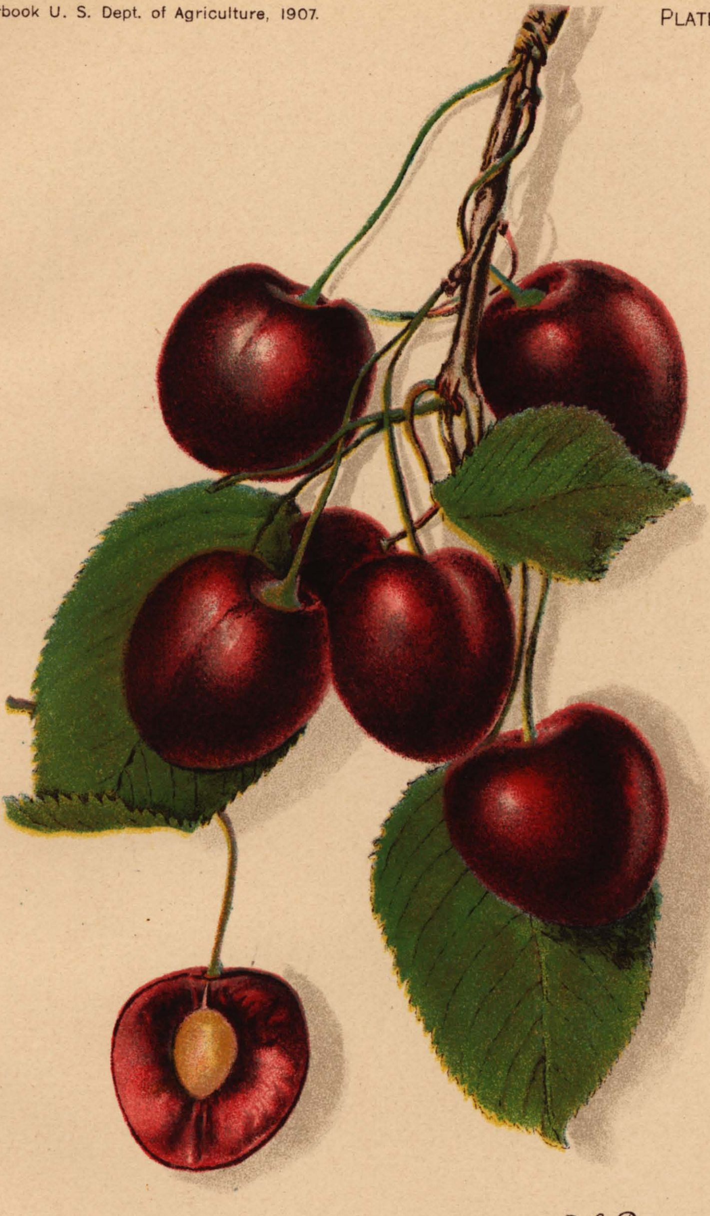
DELICIOUS APPLE.

THE SACKETT & WILHELMS CO., N. Y.



ENSEE APPLE.

THE SACKETT & WILHELMS CO., N. Y.



LAMBERT CHERRY.

THE SACKETT & WILHELMS CO. N. Y.

bling, meaty, juicy; flavor sweet, rich; quality good to very good. Season rather late, following Bing.

The fruit is borne in large clusters, a twig $3\frac{1}{2}$ inches long received in 1907 having 23 well-developed fruits upon it. The tree is a strong and vigorous grower, with large leaves.

The specimens illustrated on Plate XXXI were grown by Mr. J. R. Nunnamaker, Hood River, Oreg.

MILLER PERSIMMON.

[PLATE XXXII.]

While the Japanese persimmon or kaki (*Diospyros kaki*) has received much more attention from American fruit growers than our native species, the most widely distributed and abundant of these, *Diospyros virginiana*, is gradually creeping into cultivation and will doubtless eventually be recognized as an important economic species throughout our southern States. Though lacking the large size and brilliant color of the Oriental type, the superior hardiness of the tree of the native species, coupled with its regularity of bearing and endurance of climatic vicissitudes, largely compensates for these shortcomings. The choice varieties that are gradually being brought to light are also of richer flavor and finer quality than any of the Japanese sorts yet introduced.

One of the largest and most promising of these from the commercial standpoint is the Miller, which was discovered by Col. J. C. Evans in 1894, in Jackson County, Mo., in an abandoned field on the farm of a man bearing that name.[a] Colonel Evans secured scions from this tree and now has an orchard of 200 trees of the variety in bearing. He finds it a regular and abundant bearer and markets the fruit in Kansas City and other city markets in 8-pound grape baskets, which usually sell for 50 to 75 cents. At these prices he considers it the most profitable fruit he grows. He contemplates using paper boxes of a size that will hold about 1 dozen persimmons, so that the fruit can be left on the tree until it begins to soften and still stand shipment for considerable distances.

DESCRIPTION.

Form roundish oblate; size large to very large for its class; cavity regular, small, shallow; calyx large, 4 or sometimes 5 parted; stem short, moderately stout; apex a point protruding from a very slight depression; surface moderately smooth; color reddish, translucent, covered with profuse bluish white bloom; flesh yellowish, translucent, with yellow veins and quite meaty; seeds medium, plump, broad, brown, rather numerous; flavor sweet and rich, though

[a] Letter of J. C. Evans, Harlem, Mo., October, 1907.

slightly astringent until fully ripe and soft. It ripens in September in Jackson County, Mo., on thin dry land, but on richer soil and under cultivation is considerably later and can be marketed during a period of several weeks during autumn and early winter without resorting to cold storage. The specimens illustrated on Plate XXXII were grown by Col. J. C. Evans, Harlem, Mo.

The tree is a strong grower and regularly productive. It is considered worthy of testing in all persimmon-growing sections where a large variety, ripening late, is desired.

RUBY PERSIMMON.

(SYNONYM: *Little's Ruby.*)

[PLATE XXXIII.]

This choice variety was disseminated by the late James A. Little, of Cartersburg, Ind., about 1897,[a] the exact time and place of its origin being at the present time unknown. It is supposed to have reached Mr. Little in the form of scions from a correspondent.[b] It has been somewhat confused with a variety experimentally disseminated by the late Judge Samuel Miller about 1899 or 1900 under the same name, which was found as a wild tree on his grounds at Bluffton, Mo., about 1883.[c]

DESCRIPTION.

Form roundish oblate; size medium; cavity regular, of medium size, shallow; calyx 4-lobed, entire; stem short, rather slender; apex small, protruding; surface smooth; color yellowish red, shading into deep red, and covered with a thin whitish bloom; dots minute; skin thin, rather tender; seeds rather small, plump, brown, few (4 to 6); flesh translucent, dark orange color, meaty, moderately juicy, sweet, though with a slightly astringent aftertaste until fully ripe; quality very good.

Season variable, ripening without frost, though hanging to the tree until after freezing if not harvested earlier. The tree is abundantly productive in Hendricks County, Ind., and is reported to be so at Farmingdale, Ill., by Mr. Benjamin Buckman,[d] who has fruited it there. Though of only medium size, the earliness, beauty, fine quality, and productiveness of this variety render it very promising for growers in the more northern portions of the persimmon region.

Mr. Little reported that he was unable to supply the demand for it in the Indianapolis market at 10 cents per pint when marketed in

[a] Letter of F. O. Harrington, Williamsburg, Iowa, March, 1908.

[b] Letter of Alonzo Little, Cartersburg, Ind., March, 1908.

[c] Letter of Samuel E. Miller, Bluffton, Mo., March, 1908.

[d] Letter of Benj. Buckman, Farmingdale, Ill., Nov. 1, 1907.

MILLER PERSIMMON.

THE SACKETT & WILHELMS CO., N. Y.

RUBY PERSIMMON.

THE SACKETT & WILHELMS CO., N. Y.

common pint berry boxes packed in crates. With this and other varieties he found that the number of seeds per fruit was considerably less when they were grown at a distance from male trees, though the flavor and quality of the fruit appeared to be slightly lowered as the number of seeds was reduced. The specimens illustrated on Plate XXXIII were grown by the late James A. Little at Cartersburg, Ind.

KING ORANGE.

(SYNONYM: *King of Siam.*)

[PLATE XXXIV.]

This most interesting and delicious orange has, from the time of its introduction to this country, been classed with the mandarins and tangerines under *Citrus nobilis*, but is so distinct in tree, fruit, and time of ripening from the "kid glove" representatives of that species that it appears worthy of recognition as a distinct horticultural group if not as a subspecies. It is apparently the first citrus variety of high quality to reach the United States by direct importation from the early home of the genus in farther India, rather than by slow migration through western Asia and the Mediterranean region of Europe.

The variety appears to have been introduced through the interest aroused in the mind of Mrs. Dr. S. R. Magee,[a] of Riverside, Cal., by an account in a magazine of an orange of high quality grown in China. In an effort to secure trees of this she wrote to her personal friend and former fellow-townsman, Hon. John A. Bingham, then United States minister to Tokyo, for assistance. This correspondence resulted in the shipment by Minister Bingham to Doctor Magee of six fruits secured at Saigon, Cochin China, packed in powdered charcoal, which reached him in February, 1880, after having been about two months in transit.[b]

Two of these fruits were decayed when received, but one of the sound ones, which was tested on arrival, was pronounced by those who tasted it superior in texture and flavor to any oranges previously tested by them. It was stated in the reports published at the time that Minister Bingham reported when he sent the fruits that the gardener in the "Imperial Gardens," from which the fruit was taken, stated that it would be almost impossible so to pack the trees that they would stand so long a journey, but that this fruit could be propagated from the seed. Doctor Magee accordingly planted the seeds of these oranges and grew from them by the following autumn 30 seedlings a foot high. He had meanwhile renewed the request

[a] Statement of Mrs. J. K. Magee, Los Angeles, Cal., April 6, 1908.

[b] Riverside Press and Horticulturist, February 14, 1880, and October 16, 1880.

for trees of the variety, and in October of the same year received from Minister Bingham, via S. S. *Peking*, a box containing "twenty-five young plants of the King Orange,"[a] sent just as they were received from Saigon. Minister Bingham stated that he had secured these through the favor of his esteemed colleague, Mons. R. de Bollay, chargé d'affaires of France in Japan. These imported trees appear to have been seedlings and from the botanic garden at Saigon, where the French had been in control for some thirteen years prior to 1880.

Whether both the imported trees and the seedlings grown by Doctor Magee were budded from is not entirely clear, but that more than one seedling tree was thus perpetuated seems strongly probable and possibly accounts for the rather wide range in habit of growth, thorniness of wood, and quality of fruit found under this varietal name to-day.

Doctor Magee appears to have first sold trees of it in 1882,[b] but so far as known the variety was first fruited in America by Mr. J. E. Cutter about 1885 on top-budded trees, specimens grown by him having been sent to the New Orleans Exposition in that year. Mr. Cutter sent specimens of the fruit to the late William Saunders, Horticulturist of the Department of Agriculture, in March, 1887,[c] these being the first that reached the Department. Mr. Cutter is reported to have developed a much less thorny strain than that first disseminated,[d] and most of the stock of King grown in Florida appears to trace to his dissemination of the variety, though according to Reasoner[e] two of the imported trees and buds from others were sent to Mr. John Carville Stovin at Winter Park, Fla., in 1882, presumably by Doctor Magee. The variety also reached Florida in 1882 in the form of buds received from Doctor Magee by the Beed, Knox & Beed Company, of Bulow, Volusia County, in July of that year.[f] These buds were considered by Mr. L. B. Knox to have been cut from a single tree, and as the trees grown from them were very thorny Mr. Knox and his associates practiced systematic bud selection in their propagation with a view to getting rid of the thorns. In this effort they rebudded some of the trees twice in a season, and were eventually successful in reducing the thorniness to a considerable extent. About 1884 and for some time thereafter they disseminated the variety considerably through Florida. On March 10, 1887, they

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[a] Letter of Hon. John A. Bingham to Dr. S. R. Magee, September 16, 1880, furnished by Doctor Magee's daughter, Mrs. Cunningham, of Riverside, Cal., April, 1908.

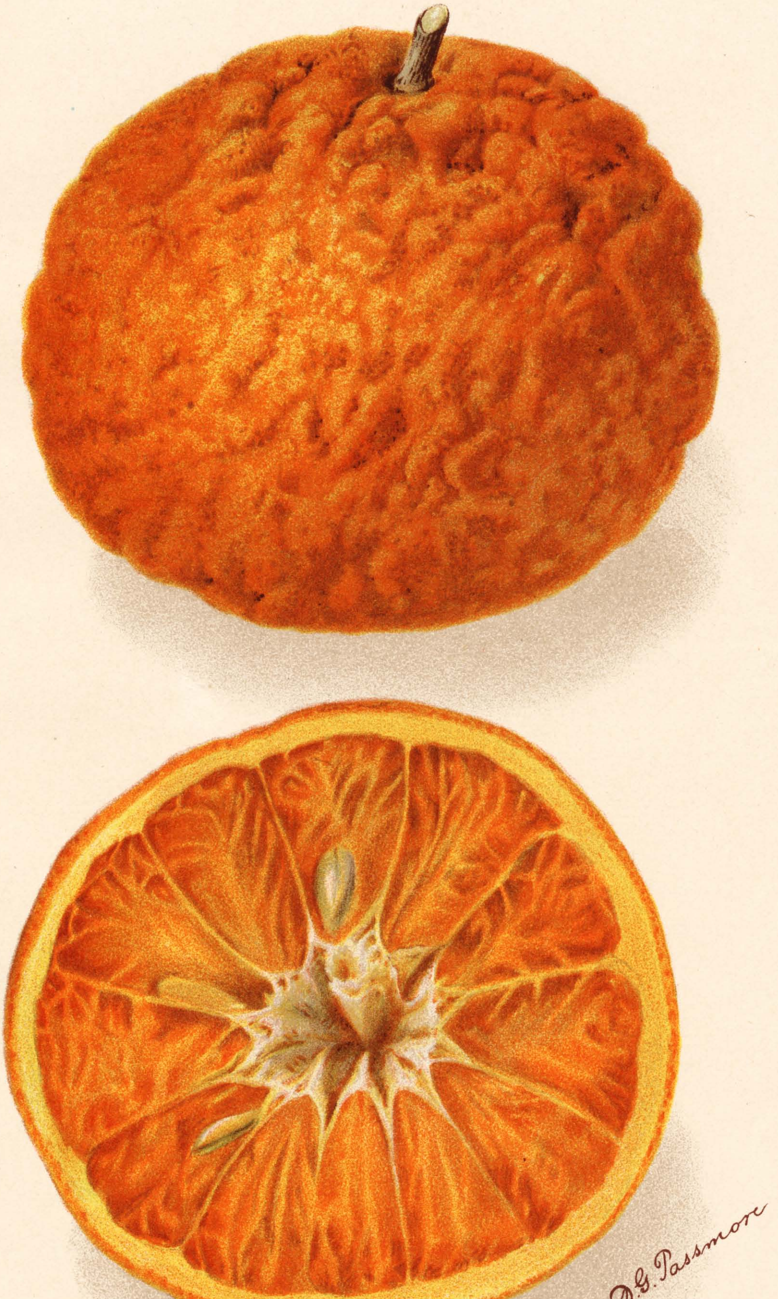
[b] Riverside Press and Horticulturist, July 8, 1882.

[c] Letter of J. E. Cutter to William Saunders, March 12, 1887.

[d] Letter of E. L. Koethen, Riverside, Cal., March, 1908.

[e] Division of Pomology Bulletin No. 1, 1888, p. 73.

[f] Letter of L. B. Knox, April 22, 1908.



KING ORANGE.

THE SACKETT & WILHELMS CO., N. Y.

shipped to New York the first box of fruit of the variety marketed in the United States. This box is reported to have sold for $7 in that market.

The variety has not proved well adapted to the present citrus districts of California and has attained little commercial importance there. In certain localities in Florida it attains high perfection, however, and when well grown, so as to be free from thorn scars and sunburn, it brings higher prices in northern cities late in spring than any other variety grown in that State.

The tree is of stiff and upright habit, sprawling awkwardly when in fruit, and is peculiarly subject to breakage of limbs, owing to the brittleness of its wood. As introduced the variety was very thorny, but the strain disseminated by Mr. Cutter is a distinct improvement in this respect. The evident close reproduction of the more important and desirable characteristics through seed suggests the strong probability of the existence of other desirable allied sorts in the region from which it came.

DESCRIPTION.

Form oblate to roundish oblate, often irregular; size medium to large; surface lumpy and uneven, frequently giving the fruit a rather uncouth appearance; oil cells large, numerous, depressed; color dark reddish orange; base often contracted and grooved; calyx small; stem slender; apex an irregular dot in a broad, shallow depression; rind moderately thick, rather soft, and possessing a distinctive aroma and flavor, agreeable to most persons; much more closely adherent to the flesh than that of the true mandarins; segments 10 to 13, fairly even in size, rather loosely attached, leaving an open, pithy center; flesh very dark orange, loose and soft in texture, with large, tender juice vesicles; seeds rather numerous, medium to large, long, pale green; juice abundant, having a rich orange color when fully ripe and a peculiarly rich, sweet, sirupy flavor, with a distinctive and agreeable aroma; quality very good; season late, March to May in the Florida orange districts.

As found in the markets the fruit of King is quite variable, the same "strap" or half box often containing specimens of the very highest quality and flavor with others of indifferent quality. This fruit probably needs more protection against sudden and extreme climatic changes than most varieties of its class, but taken at its best it ranks with the very best oranges in quality and is therefore worthy of the attention of commercial growers for special markets that demand and will pay for such quality. The specimen illustrated on Plate XXXIV was grown by Mr. John Fabyan at Conant, Lake County, Fla.

SANDERSHA MANGO.

(SYNONYMS: *Sandershaw, Soondershaw, Sundershah.*)

[PLATE XXXV.]

Since the superiority of quality of the choice Indian varieties of the mango over that of the common seedlings of tropical and subtropical America became evident through the fruiting of the Mulgoba in Florida in 1898 and subsequent years, there has been an active interest in the introduction of other reputed choice varieties of this most interesting fruit. A large number of such have been brought from India and some from other tropical countries by the Office of Seed and Plant Introduction of the Bureau of Plant Industry, while private enterprise has become sufficiently interested to import considerable numbers of certain sorts.

Of those that have fruited sufficiently in Florida thus far to disclose their distinctive characteristics, the Sandersha is one of the most unique and in certain respects the most promising. It was introduced by the then Section of Seed and Plant Introduction in 1901[a] (S. P. I. No. 7108), having been received from A. Lehmann, Ph. D., Bangalore, India, on July 31 of that year in the form of two inarched trees. A second lot of inarched trees received from Mr. W. Gollan, superintendent of the Government Botanic Garden at Saharanpur, India, under the name "Sundershah" (S. P. I. No. 10665) has not yet fruited, but is supposed to be the same sort. Little appears to have been published in India regarding the variety, but at the Subtropical Laboratory of the Department at Miami, Fla., where it has been fruited for two seasons, it has proved very productive, of exceptionally large size, fine dessert quality, and very late ripening season, all of which points are apparently in its favor as a commercial sort. Mr. P. J. Wester, of the Subtropical Laboratory, considers cross pollination necessary to insure productiveness.

DESCRIPTION.

Form long, compressed, and rather slender, tapering toward stem and terminating in a distinct curved beak at the apex; size very large, averaging about 20 ounces in weight, and occasionally attaining a weight of 2 pounds; stem stout, apex prominent, curved and "beaked;" surface smooth; color clear yellow, with a faint pinkish blush in the sun; dots numerous, small, russeted; skin moderately thick; seed long, curved, thin, small in proportion to size of fruit and thickness of flesh; flesh rich reddish yellow, juicy and tender, almost entirely free from fiber; flavor sprightly and refreshing in the fresh state, though with rather less aroma than Mulgoba. Its higher acidity will doubtless render it more acceptable for serving in sliced

[a] Bureau of Plant Industry Bulletin 66, p. 131, Feb. 8, 1905.

SANDERSHA MANGO.

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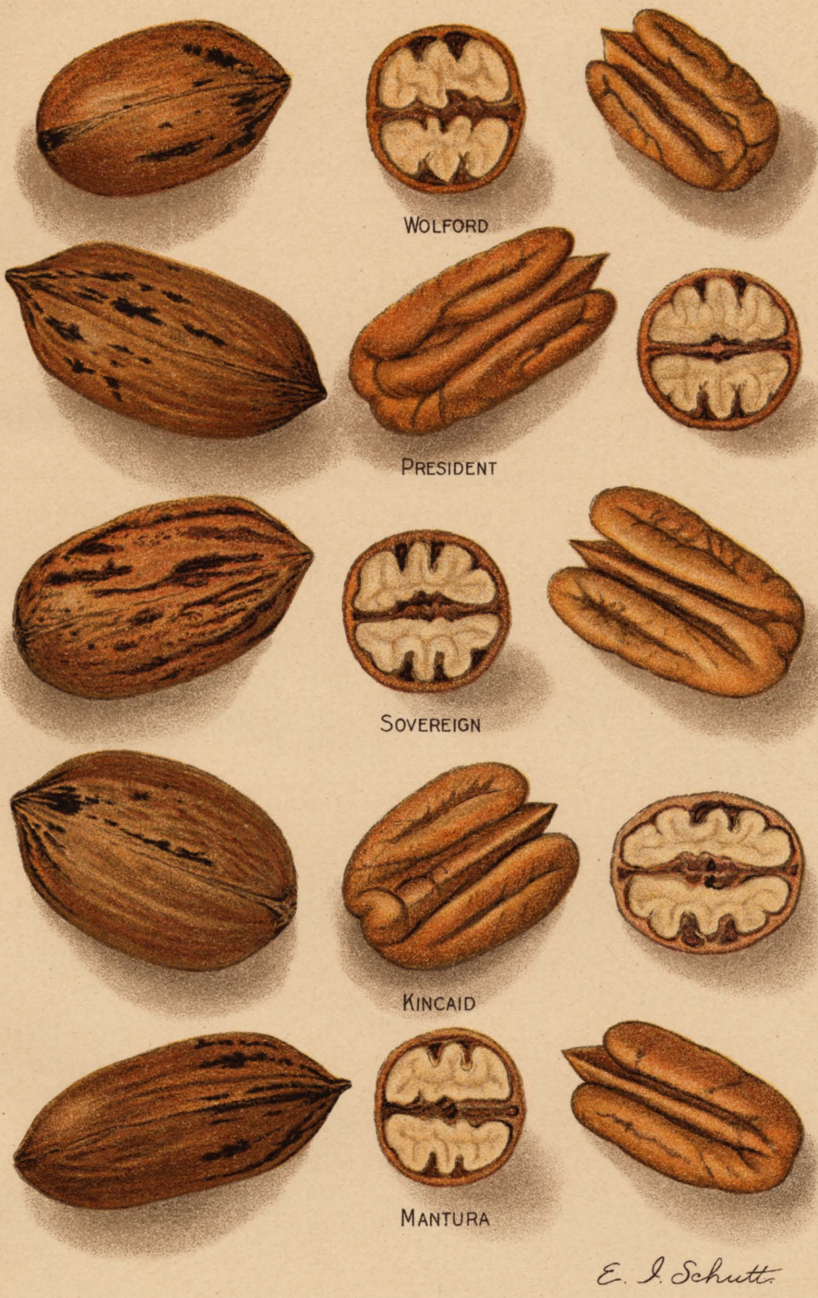

PECAN VARIETIES

THE SACKETT & WILHELMS CO., N. Y.

form than are most of the mangoes thus far obtainable in our markets. Season very late, ripening the latter part of August at Miami, Fla. Sandersha is considered well worthy of testing in the mango districts of Florida, Porto Rico, and Hawaii. The specimen illustrated on Plate XXXV was grown at the Subtropical Laboratory of the Bureau of Plant Industry at Miami, Fla.

PECANS.

[PLATE XXXVI.]

As more attention is paid to the pecan as a nut producer in distinction from it as a forest species it becomes increasingly apparent that only a very small proportion of the trees thus far brought to notice possess sufficient merit to justify their perpetuation and dissemination under distinctive names. This is especially true of varieties for commercial orchards, and emphasizes the importance of conservatism in the naming and introducing of varieties at the present juncture, when thousands of planted seedlings in orchards throughout the South are coming into bearing each year. At the same time it is recognized that whenever a seedling is found to possess important characteristics of decided superiority it should be immediately propagated, on an experimental scale at least, to insure its preservation in the event of destruction of the original tree.

WOLFORD PECAN.

The original tree of this variety is a wild seedling about 20 years old standing on land belonging to Mr. H. L. Wolford, in Wilson Creek bottom, near McKinney, Tex. It was called to the attention of Mr. E. W. Kirkpatrick about 1898 by one of his employees, with the result that Mr. Kirkpatrick began propagating it in a small way the following year. He named it in honor of the owner of the tree, and states that he published a description of the variety about 1902.[a] The original tree is so located that a considerable portion of each crop is taken by trespassers, so that its actual yield for any year has not been ascertained. It is reported to be a rather slender grower, with tough wood and narrow leaves, and bearing numerous heavy catkins. It is considered one of the most productive varieties grown in that section, bearing many clusters containing 7 or 8 nuts each. In 1907 Mr. Kirkpatrick harvested 20 pounds of nuts from one branch of it, 6 inches in diameter, that had been top-worked on a tree of bearing age.

DESCRIPTION.

Size medium or slightly below, averaging 75 to 90 nuts per pound; form oval to oblong oval, compressed, with a rather blunt, slightly

[a] Letter of E. W. Kirkpatrick, McKinney, Tex., December 11, 1907.

curved, quadrangular apex; color rather bright yellowish brown, with few and narrow velvety black markings; shell very thin and quite brittle, with thin and soft partitions, cracking easily; kernel plump, smooth, and full to the tip, with rather narrow but shallow grooves, releasing the shell easily; kernel color bright golden brown, texture fine, meaty, and solid; flavor rich, nutty, and free from astringence; quality very good.

Because of the locality of its origin this variety is worthy of testing throughout the more western pecan districts, both for family use and as a commercial variety. Its productiveness and excellent cracking quality compensate to a considerable extent for its lack of size.

The specimens illustrated on Plate XXXVI, figure 1, were grown on a top-grafted tree by Mr. E. W. Kirkpatrick, McKinney, Tex.

PRESIDENT PECAN.

(SYNONYM: *President Roosevelt.*)

The original tree of the President was grown by Griffing Brothers, of Macclenny, Fla., about 1889, from a nut obtained by them at Bagdad, Fla. The tree was sold by them in 1891 with other seedlings to a customer who planted it in Jacksonville, Fla., where it now stands. The tree is reported to have begun bearing six years after it was transplanted to Jacksonville, and has borne from 70 to 120 pounds of nuts per year in recent years prior to 1907, when it was defoliated by a hailstorm in May, which destroyed the crop. Its propagation was begun about 1902, and it was named and catalogued for sale by the originators in 1903 as "President Roosevelt." In 1904 the name was changed to "President" by the introducers.

The tree is described as a symmetrical, upright grower, but less vigorous than Rome and Van Deman.

DESCRIPTION.

Form oblong, compressed, with a rather sharply pointed base, and quadrangular apex with prominent point; color bright yellowish brown, with a few narrow and broken black stripes near apex; size large—45 to 50 per pound; shell of medium thickness for so large a nut, with thin and soft partitions, cracking easily; kernel long, rather deeply and narrowly grooved, but plump and releasing shell easily; kernel color bright and attractive, texture rather fine-grained for so large a nut; flavor pleasant, free from astringence; quality very good.

This variety is considered one of the most promising large sorts that has originated in Florida and is considered worthy of testing in that State and adjacent pecan districts.

The specimens illustrated on Plate XXXVI, figure 2, were grown in Jacksonville, Fla.

SOVEREIGN PECAN.

(SYNONYM: *Texas Prolific.*)

In 1895, shortly after he had mastered the art of ring-budding the pecan and thus had been enabled to propagate and disseminate the San Saba variety from the original tree of that sort, which stands on his place,[a] Mr. E. E. Risien, of Rescue, Tex., planted San Saba nuts from the original tree for the purpose of growing a considerable orchard of seedlings of that variety. He did this in the expectation that a large proportion of the seedlings would come true to the parent, which they failed to do. Certain of the young seedlings early gave evidence of distinctiveness, through their leaf and wood characters, so that as early as 1897 he began top-budding from them on to bearing trees in order to determine as quickly as possible their fruiting quality and other characteristics. A bud from one of these which was thus top-worked in 1897 on an old bearing tree on the San Saba River bottom bore its first nuts in 1898. The precocity thus indicated and the large size, bright color, plump kernel, and fine quality of the new sort caused Mr. Risien to name it "Sovereign" early in 1899, at the suggestion of Mr. A. A. Wheeler, of San Francisco, to whom some of the first crop of nuts had been sent. The exact location in the orchard of the original seedling tree not having been recorded, Mr. Risien began nursery propagation from the bearing top-worked branch and disseminated the variety in the form of 1-year-old ring-budded trees under the name "Sovereign" in 1900. A brief characterization of the variety by the writer, based on specimens of the crops of 1899 and 1900, was published under that name in the Cyclopedia of American Horticulture in 1901.[b] Meanwhile Mr. Risien listed the variety as "Texas Prolific" in his price list for 1900–1901, which was apparently issued in the fall of 1900. As the latter name consists of more than one word and is otherwise in conflict with the Code of Nomenclature of the American Pomological Society, which has also been adopted by the National Nut Growers' Association, the name "Sovereign" is recognized as having precedence and is adopted in this publication. The top-budded branch above referred to continued to thrive and bear good crops until the season of 1903, when a June freshet in the San Saba River flooded the entire bottom well into the tops of the old bearing trees. The force of the flood and the weight of the driftwood that it carried broke the entire budded branch with its load of nuts from the tree. Fortunately the branch was discovered by Mr. Risien after the flood subsided and before the leaves upon it had wilted. He immediately cut all available bud wood from it, with which he budded about 200

[a] Yearbook 1904, p. 413.

[b] Cyclopedia of American Horticulture, Vol. III, p. 1256, 1901.

young seedlings then growing in his nursery. Of these about 75 lived, thus preserving a good stock of the variety. Close watch has been kept of the trees in the seedling orchard in the hope that the original tree of the Sovereign could be located when it came into bearing, but without success. In the autumn of 1907 Mr. Risien reluctantly concluded that it must have been one of several that had been washed out bodily in some of the freshets which are experienced frequently in that section. The importance of prompt propagation of valuable seedlings in order to insure their perpetuation in the event of the loss of the original tree is emphasized by this experience.

DESCRIPTION.

Size large, averaging 50 to 55 nuts per pound; form oblong to oblong obovate, compressed, with a full and smooth base and a blunt and usually symmetrical apex; surface quite lumpy, conforming to the undulations of the kernel; color bright, yellowish, with long, narrow, striped markings, ranging from bright red to reddish brown in color; shell thin to medium for so large a nut, not a distinct paper shell, like San Saba, Russell, Young, and a few others, but brittle and cracking easily; kernel plump, rather narrowly and deeply grooved, and considerably convoluted, not releasing the shell as easily as some; kernel color bright and clear; texture very fine grained and firm; flavor sweet, rich, nutty, quality very good. The specimens illustrated on Plate XXXVI, figure 3, were grown by Mr. E. E. Risien, Rescue, Tex.

The tree is a moderately strong grower, more vigorous than its parent San Saba, but of the same general character. The variety is considered especially worthy of testing in the more western and arid pecan districts. It has been experimentally planted throughout the South, but not for a sufficient length of time to determine its adaptability to the more humid eastern sections.

KINCAID PECAN.

This variety was brought to light by Mr. E. E. Risien, then of San Saba, Tex., through the offering of a premium for the best variety of pecans brought to him during each season. The tree proved to be a sprout from a stump on land in Wallace Creek bottom in San Saba County, Tex., owned by the late James Henderson and occupied at the time by a Mr. Kincaid, who rented the place. The tree is reported to have since been killed by fire built against it by campers.

The variety was first propagated about 1900 by Mr. Risien and was disseminated by him under that name in the same year.[a]

The tree is reported by Mr. Risien to be a vigorous though rather

[a] Letters of E. E. Risien, Rescue, Tex., March, 1908.

slender grower, with small narrow leaves with red markings on their stems. It blooms profusely, but rarely sets more than 2 or 3 nuts to the cluster and is therefore considered but moderately productive, though a regular bearer of fair crops. It is reported much easier to bud than either San Saba or Sovereign.

DESCRIPTION.

Size large, averaging 45 to 50 nuts per pound; form broad oblong, compressed, with flat base and blunt quadrangular apex; surface rather smooth, but considerably ridged, especially toward apex; color bright, brownish, with a few scattered brownish splashes toward apex; shell medium in thickness with rather thick but soft partitions, cracking quite easily; kernel broad, flat, plump, smooth, releasing the kernel easily, darker than Sovereign or San Saba, but exceptionally attractive for confectioner's use on cakes or candies; texture rather coarser than the above-named varieties, but decidedly finer than the average commercial pecan; flavor mild, pleasant; quality good. The specimens illustrated on Plate XXXVI, figure 4, were grown by Mr. E. E. Risien, Rescue, Tex.

This variety is especially commended by Mr. E. W. Kirkpatrick, who has given much attention to the examination of Texas pecans, and is considered worthy of testing in the pecan districts from that State westward.

MANTURA PECAN.

So few of the pecan varieties yet found worthy of naming have originated north of the cotton belt that the discovery of a tree bearing good crops of nuts of fair size and good quality regularly as far north as Virginia appears worthy of special note. Such a one the Mantura appears to be. The original tree of this variety stands on the homestead of that name about 5 miles from the James River, in Surry County, Va.[a] The tree is one of four grown from nuts planted by Mrs. Wilson, mother of Mr. W. P. Wilson, Fergussons Wharf, Va., the present owner, about 1866. The nuts planted came from a tree still standing at Surry, about 9 miles distant. The Mantura tree is about 11 feet in circumference and 80 to 90 feet high, with a symmetrical spread of top. Up to 1907 it had not missed a crop for fifteen or twenty years, the crop for the previous ten years having averaged 100 pounds and for several years 150 to 275 pounds. Like practically all pecans in the Eastern States the crop of 1907 was very light, owing probably to late frosts and wet weather in spring. The variety attracted the attention of Mr. W. N. Roper, who named it Mantura in 1906 and began its propagation. It was described and illustrated by Hume under that name in 1906.[b]

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[a] Letter of W. N. Roper, Petersburg, Va., June 1, 1906.

[b] The Pecan and Its Culture, 1906, p. 44.

DESCRIPTION.

Size medium to large, averaging 60 to 65 to the pound, form long, rather slender, with pointed base and rather blunt apex; surface smooth, color rather bright, with narrow black markings at apex; shell thin, partitions thin and soft; cracking quality excellent; kernel long, slender, not always plump to the tip, but smooth and attractive, with narrow but shallow grooves; kernel color bright and clean; texture fine-grained, firm, oily; flavor sweet; quality very good. The specimens illustrated on Plate XXXVI, figure 5, were from the original tree.

THE DETAIL OF THE ENFORCEMENT OF THE FOOD AND DRUGS ACT.

By W. D. Bigelow,

Assistant Chief, Bureau of Chemistry; Chief, Division of Foods.

ORGANIZATION.

The food and drugs act of June 30, 1906, commonly called the "pure food law," forbids the importation into the United States, the exportation from the United States, the introduction into interstate commerce, and the manufacture and sale in the District of Columbia and the Territories of misbranded and adulterated food and drugs.

The law is administered under the direction of the Secretary of Agriculture and provides that the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor shall make uniform rules and regulations for carrying out its provisions. Such regulations have been made and are printed, together with the act, for distribution by the Department of Agriculture. The opinion of the Department regarding various features of the law is expressed in Food Inspection Decisions published from time to time from the Office of the Secretary.

The organization charged with the enforcement of the law includes: (1) Inspectors who procure samples for analysis and information regarding the manufacture and sale of food and drugs; (2) chemists and clerks, in the laboratories of the Bureau of Chemistry in Washington and in the branch laboratories in other cities, of which 16 are now in operation and 3 are being installed; (3) the Board of Food and Drug Inspection, whose duties are to consider all questions arising in the enforcement of the food and drugs act of June 30, 1906, upon which the decision of the Secretary of Agriculture is necessary; to consider and supervise all correspondence involving interpretations of the law and questions arising under the law; and to conduct all hearings based upon alleged violations of the food and drugs act of June 30, 1906.

Information secured by the inspectors and laboratories regarding violations of the law is reported by the Chief of the Bureau of Chemistry to the Board of Food and Drug Inspection, which, when the charges appear to be sustained, makes recommendations to the Secretary of Agriculture regarding the exclusion of adulterated and misbranded food and drugs offered for importation, and prosecutions for the sale of domestic goods in violation of the law. All persons charged with violations of the law are afforded a hearing at

which they may introduce testimony. As stated below, this hearing is usually conducted by the Board of Food and Drug Inspection or by the chiefs of the respective branch laboratories. When requested, however, the hearing is conducted personally by the Secretary of Agriculture. The act provides that its penalties shall not be visited upon dealers protected by a guaranty, and in enforcing the law the Department attempts to protect the retail dealer who may be acting in good faith and to place the responsibility upon the shipper or manufacturer who is aware, or should be, of the nature of the product.

The enforcement of the law naturally proceeds along two lines: First, products imported into the United States from foreign countries; and, second, products manufactured or sold in the District of Columbia or the Territories, introduced into interstate commerce, or exported from the United States.

INSPECTION OF IMPORTED FOODS AND DRUGS.

In the case of imported foods and drugs no prosecutions are made. The effort of the Department in enforcing the law is confined to preventing the importation of illegal goods and causing their reshipment beyond the jurisdiction of the United States. The inspection of imported foods was begun on July 1, 1903, under authority conferred by Congress in the appropriation act for the Bureau of Chemistry, and was in full operation at the time of the passage of the food and drugs act. In organizing for the enforcement of the food and drugs act, therefore, it was only necessary to adapt and elaborate the organization that already existed.

INVOICES AND CERTIFICATES.

All consignments of merchandise to the United States valued at over $100 are invoiced before a United States consular officer, and since the beginning of the enforcement of the imported food law copies of these invoices are forwarded to the Bureau of Chemistry. The invoice consists of a list of the articles in the consignment, with the amount and value of each, and is intended to facilitate the collection of duties. To each invoice of foods or drugs is attached a declaration in which a statement is made by the shipper as to the country in which the goods were grown and manufactured, by whom and when they were manufactured, and the city from which they were exported. A statement regarding the presence or absence of coloring matter and chemical preservatives is also required, together with the name of any artificial color or preservative that may be present. It must also be declared that the goods are not of a character to cause prohibition or restriction in the country where made or from which exported.

Invoices of meat and meat food products imported into the United States must also be accompanied by a certificate of official inspection of such a character as to satisfy the Secretary of Agriculture that they are not dangerous to health, and each package of such articles must bear a label which shall identify it as accompanied by the certificate. The certificate must also set forth the official position of the inspector and the character of his inspection, and be attested by the proper official of the country, district, or city in which the meat is manufactured. It must be certified that the animals from which the meat was prepared were subjected to competent official veterinary ante-mortem and post-mortem inspections; that it is the product of animals free from disease; and that it is free from chemical preservatives or other foreign substances injurious to health. All food products of a kind forbidden entry into or forbidden to be sold or restricted in sale in the country in which they are made or from which exported are refused admission.

PROCEDURE AT THE PORT LABORATORIES.

During the first year of the enforcement of the imported food law all information regarding importations of foods was obtained from these consular invoices, and samples were requested of the customs officers for examination. The time consumed in the shipment of samples to Washington was found to make this procedure impracticable, and in 1904 a laboratory was established at the port of New York. This was found to expedite matters greatly, and during the following year branch laboratories of the Bureau of Chemistry were organized at Boston, Philadelphia, Chicago, New Orleans, and San Francisco. These six laboratories were therefore in active operation at the time of the passage of the food and drugs act.

Since that time additional laboratories have been equipped at Buffalo, Cincinnati, Detroit, St. Paul, Kansas City, Mo., Savannah, Galveston, Seattle, Portland, Oreg., and Denver, and laboratories are being organized at the present time at St. Louis, Mo., Pittsburg, and Omaha. At the various custom-houses the invoice submitted by the importer is filed with the examiner by whom the goods described thereon are to be appraised. The Secretary of Agriculture has made a general request upon the Secretary of the Treasury that an opportunity be afforded representatives of the Department of Agriculture to inspect shipments of imported foods and drugs, and that such samples as they may deem necessary be furnished them. The Secretary of the Treasury has accordingly instructed collectors of customs to afford such opportunities and supply such samples to the chiefs of branch laboratories at their respective ports. No invoice containing a food or drug product is permitted to be returned by the examiner until it has been inspected by a representative of the Department

of Agriculture. If an invoice contains an article of food or drugs which this representative desires to inspect, he attaches to it a small tag, designating the article of which he desires a sample and the amount of sample desired. If, in his opinion, it is not necessary to inspect samples of any products described on the invoice, the inspecting officer stamps the invoice with a statement that no sample is desired.

It is frequently impossible for the inspector to determine from the examination of the invoice whether it would be advisable to send a sample of the consignment to the laboratory. The brand of goods contained on the consignment may be one with which the inspector is not acquainted, or its description on the invoice may be inadequate. In such cases the inspector attaches to the invoice what is termed a "detention tag." The examiner is instructed that when a shipment of foods described by an invoice so designated reaches him, he shall notify the chief of the food and drug inspection laboratory of the Department of Agriculture, and give him an opportunity to inspect the shipment on the floor and decide whether a sample is desired or not. The detention tag is especially useful in the case of foods on whose labels a declaration of some ingredient or ingredients is required. Frequently the inspector only requires to see the label to determine whether or not the proper declaration occurs. Sometimes an analysis is necessary to determine whether such declaration should have been made or whether the nature of the goods has been changed since previous inspections. After seeing the shipment the inspector decides whether or not a sample should be taken for the inspection laboratory. He then tears off the yellow detention tag and either stamps the invoice with a statement that no sample is desired or affixes a sample tag, requesting the amount of sample needed.

It is thus seen that eventually the inspector marks each invoice of food products, either by stamping on it the statement that no sample is desired, or by affixing to it a tag requesting the amount of sample that shall be sent to the laboratory. On the arrival of the goods represented by an invoice that is marked with a sample tag, the examiner forwards a sample to the laboratory. When the shipment is appraised on the docks, as is done with certain articles, the examiner sends an order for the sample to the proper officer.

Owing to the large volume of importations it becomes a matter of the utmost importance to the customs authorities that appraisement be made as expeditiously as possible. Any delay is likely to cause an accumulation of merchandise that seriously interferes with the work of the customs officers and with commerce. It becomes a matter of the utmost importance, therefore, so to arrange the inspection of food and drugs as to interfere as little as possible with the inspection of the customs service incident to the appraisement of merchandise for levying duty.

Samples requested by the inspector are delivered to the branch laboratory of the Bureau of Chemistry at the earliest possible moment. These samples are examined as quickly as practicable and if, in the opinion of the chief of the branch laboratory, they conform to the law, the importer is notified that no further action will be taken by the Department of Agriculture. This notice is usually sent him even when the chief of the laboratory is in doubt regarding the proper disposition of the case, and more time is required for the solution of the problems that present themselves. In such cases, if it is found at a later date that the shipment should not have been released, the importer is notified that such release was made without prejudice to future decisions, and if possible he is informed why the product is regarded as adulterated or misbranded.

If, in the opinion of the chief of the branch laboratory, a consignment is in violation of the law, the importer is notified of that fact and is given an opportunity to present evidence regarding the matter. The importer is given a hearing before the Secretary of Agriculture if he desires it. At the same time, a sample of the consignment is sent by the branch laboratory to the Bureau of Chemistry in Washington, where a check analysis is made. A decision regarding the case is then made, taking into consideration the invoice on which the product was imported, the label, the analytical results, and the evidence offered by the importer at the hearing. This inspection does not delay the delivery of goods to the importer. He takes immediate possession of them on the execution of a penal bond to deliver them to the collector of customs on demand or forfeit the full value of the goods, together with the full duty thereon. It will be noted that the branch laboratories do not have the authority to exclude shipments of food or drugs from importation in any case. This action is only taken by the Secretary of Agriculture on the recommendation of the Board of Food and Drug Inspection.

The violation of the food and drugs act by importing adulterated or misbranded food or drugs into the United States is, therefore, not punished, as in the case of interstate transactions, by fine or imprisonment. The requirement that these goods be reshipped is found to be sufficient penalty.

INSPECTION OF DOMESTIC PRODUCTS.

From the nature of the case the method of inspecting domestic foods and drugs is necessarily widely different from that employed with imported goods. For this purpose inspectors visit all sections of the country to secure samples for analysis and such information as may be required by the Department. One inspector is located at each of the branch laboratories and others have their headquarters at Burlington, Vt., Albany, Baltimore, Norfolk, Birmingham, Knoxville,

Memphis, Louisville, Charleston, W. Va., Des Moines, Oklahoma City, Dallas, Tucson, Salt Lake City, Spokane, and Fargo.

DUTIES OF INSPECTORS.

The duties of the inspectors are as follows: (1) To investigate the wholesale and retail market and obtain samples of foods and drugs shipped in interstate commerce. (2) To inspect manufacturing establishments and secure information in regard to the nature of the foods shipped in interstate commerce. (3) To investigate the manufacture and use of substances which are or may be employed for the adulteration of foods and drugs and methods of preparation which may lead to the damage or deterioration of foods and drugs, or to the use of improper materials in their manufacture. (4) To inspect foods and drugs imported at ports where branch laboratories have not been established. In addition to these duties, special investigations are frequently made by inspectors concerning important questions of sanitation and processes of manufacture. As already stated, one inspector is located at each branch laboratory, and aside from his regular duties, as just outlined, devotes considerable time to securing information regarding the alleged illegal use of imported foods and drugs in collaboration with the chief of the laboratory. Though the inspectors so assigned spend but little time at the laboratories they report daily for consultation unless on a special assignment.

Inspectors do not maintain offices and, with the exception of those whose headquarters are at the Bureau of Chemistry, or at the various branch laboratories, usually spend but a small portion of their time at their headquarters. It is not in their province to give information regarding the policy of the Department or the interpretation of the law. Their routes of travel, the towns they visit, the questions they investigate, and the classes of samples they secure are planned by the chief inspector at Washington under general directions from the Chief of the Bureau of Chemistry. Their directions are thus in many respects specific and at the same time they have every opportunity for individual initiative. They are not expected merely to study the special problems which are presented by the chief inspector for solution, but to observe all conditions that exist in their locality regarding the manufacture and sale of foods and drugs, and to report to the Bureau all violations of the law that come within their observation. The efficient and complete enforcement of the law, therefore, depends to a large degree upon the originality and initiative of the inspectors. In order to protect the public from impostors, inspectors are provided with an identification card, signed by the Secretary of Agriculture, and inclosed in a case opposite a photograph of the inspector, on which is imprinted the seal of the Department of Agriculture.

HEARINGS.

The samples secured by the inspectors are forwarded to the Bureau of Chemistry at Washington, or to the branch laboratory most convenient to the point at which they are taken. They are there examined and if found to be in violation of the law the dealer or shipper is given an opportunity to appear before the Secretary of Agriculture, or such official as he may designate, and present evidence in reference to the question at issue.

These hearings are usually held by the Board of Food and Drug Inspection at the Department of Agriculture in Washington, or at the branch laboratory most convenient to those concerned in the particular case at issue. When requested, the hearings are conducted personally by the Secretary of Agriculture. These hearings are for the purpose of affording the manufacturer, shipper, or dealer an opportunity to show that an error has been made in either the collection or analysis of the sample or the interpretation of the results. He may also produce evidence of a guaranty from the person from whom he obtained the consignment of which the sample is a part.

PROSECUTIONS.

At the conclusion of such a hearing the information obtained is taken into consideration, together with the data secured by inspectors and chemists in connection with the sample. If the hearings are held at a branch laboratory the findings are considered subsequently by the Board of Food and Drug Inspection, which Board decides in all cases whether a prosecution shall be brought. If it appears that the law has been violated the Board makes the appropriate recommendation to the Secretary of Agriculture, who certifies the fact to the proper United States attorney through the Attorney-General, together with the necessary information regarding the case,

It is then the duty of the district attorney to prosecute the case promptly in the United States district courts. The authorities charged with the enforcement of the health, food, or drug laws of the various States and Territories are also empowered, when authorized by the Secretary of Agriculture, to institute proceedings through the United States district attorneys for violation of the food and drugs act.

SEIZURE AND CONFISCATION OF ILLEGAL GOODS.

The law also provides that adulterated or misbranded food or drugs sold or offered for sale in the District of Columbia or the Territories, imported, delivered for export, or introduced into interstate commerce, may be seized and disposed of by destruction or sale as the court may direct. The owner may in the discretion of the court be

put in possession of such goods, however, on paying the costs of the proceedings and executing and delivering a bond that the articles shall not be disposed of contrary to the provisions of this act or to the laws of any State, Territory, district, or insular possession.

In seizure proceedings no hearings are given before the Secretary of Agriculture. This procedure is based on an opinion of the Attorney-General and is in harmony with the ruling of the Federal courts in which seizure cases have already been tried.

INFORMATION IN REGARD TO SPECIFIC PRODUCTS.

No information relative to any case is given out, except to the manufacturers and dealers concerned, until the judgment of the court has been secured, when notice by publication is authorized by the law. If, therefore, the hearing given the manufacturer or dealer should disclose that an error had been made, it could be easily rectified without any injustice to the reputation of a brand of goods or those interested in its manufacture and sale. The information given the manufacturer or dealer is confined to a specific statement as to the manner in which a certain food or drug product fails to comply with the law. The complete results of analysis are not given under any circumstances.

No specific information regarding any particular brand of goods is given, except such as is involved in the publication of the judgment of the court in cases that have been decided to be in violation of the law; nor is a list of unadulterated or legal foods or drugs published, although there is a large popular demand for such a list. It is felt that such a publication would be a disadvantage rather than an advantage, because in the enforcement of other laws it has been found that some firms, having secured the publication of the names of certain brands in a list of products designated as complying with the law, have subsequently so altered the nature of their goods as to make them illegal, though they still use the previous list for advertising purposes. For similar reasons no information can be given regarding the purity or nature of any particular brand of foods or drugs. It has also been found impracticable to report on the analysis of samples sent in by individuals, as requests of this nature are received in such great numbers that it would be impossible for the Bureau to comply with them. Moreover, it is the function of the Department to stop the manufacture and sale of adulterated and misbranded foods and drugs, and when this is accomplished specific information about particular brands could be of no interest or value. While it is plainly the purpose of the majority of the manufacturers and dealers to comply with the law, and the character of the foods and drugs on the American market has been greatly improved since its enactment, the prosecution of those who seek to evade it will doubtless cause still further improvement.

THE RABBIT AS A FARM AND ORCHARD PEST.

By D. E. LANTZ,
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INTRODUCTION.

The American farmer encounters many obstacles in the practice of his calling. In addition to innumerable insect enemies and plant diseases which assail his crops at every stage of growth, he has to contend against great numbers of destructive rodents. Pocket gophers, woodchucks, prairie dogs, ground squirrels, rats, mice, and rabbits levy a heavy toll upon the products of field, garden, and orchard. No actual statistics of the aggregate of annual losses due to rodent pests in the United States are available, but as early as 1861 a writer in the American Agriculturist estimated that rats alone caused losses of $10,000,000 a year in the country.[a] In Denmark the losses from rats are estimated at $3,000,000 annually;[b] while in France the total of all losses from rats and mice has been placed at $40,000,000 per year.[c] Considering the vast territory of the United States and the great numbers of her mammalian pests, the actual losses must be several times as great as they are in France.

Because of their wide distribution and great abundance, rabbits hold a prominent place among rodent pests. They are larger than rats and mice, and almost as prolific, and under some circumstances inflict upon crops and trees damages greater even than those caused by field mice.

DISTRIBUTION OF RABBITS IN THE UNITED STATES.

Rabbits are so widely distributed throughout the United States that nearly all cultivated districts contain one or more species. They occur also in the mountains and deserts remote from agriculture; and usually, as new areas are brought under the plow, rabbits are on the ground ready to attack the settler's first crops.

The common gray rabbit, or cottontail (*Lepus floridanus* and subspecies), occurs from the southern parts of Maine, New Hampshire,

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[a] American Agriculturist, 20, p. 44, 1861.

[b] Dr. Adrien Loir in Jour. d'Agri. Trop., 3, p. 369, 1903.

[c] Journ. Board Agr. Great Britain, 11, p. 50, 1904.

and Vermont southward to Florida and the Gulf of Mexico and westward to the Plains, where its range extends up the streams to the limit of trees and shrubs. Along our northern border and in the mountains the varying hare (*Lepus americanus* and subspecies) occurs, and westward to the Pacific several species of jack rabbits and smaller cottontail rabbits are found. In all, about 30 species and twice as many geographic races (subspecies) are known to inhabit North America, while the occurrence of several distinct fossil forms shows that the genus has long been established on the American continent.

PROTECTIVE POWERS OF RABBITS.

Rabbits are apparently defenseless animals, but the senses of hearing, sight, and smell are strongly developed in them and they run with great swiftness. These powers, combined with their protective coloration, largely compensate for lack of means of defense. The ears are long and erectile; the eyes are large and prominent, and, being placed at the sides of the head, enable the animal to see in nearly all directions at the same time. The long hind legs confer great leaping power and the animals can run up or down hill with almost equal facility—a fact which gives them a decided advantage over some of their enemies. All rabbits are capable of bursts of great speed, and the large species can maintain their pace for a considerable time.

BREEDING HABITS.

Our American rabbits are not so prolific as the common European species. Some of them produce three or four litters of young in a season, while others seem to breed but twice. The period of gestation is about thirty days, and the breeding season is from April to September or even later. The young are produced in natural depressions under rocks, stumps, or weeds, or in shallow burrows made by other animals. When these are lacking, the female scratches a shallow hole under a bunch of grass or weeds. In the hollow thus chosen or prepared she makes a nest of leaves or grasses and lines it with fur from her own body. Here the young, numbering from 2 to 7 (averaging in most of our species about 4), are produced. The young are fully furred and have their eyes open when born.

The female, while caring for her young, remains in the vicinity of the nest. If enemies approach, she runs away for a short distance; but when the young are attacked and cry out, she has been known to fight desperately in their defense, and even to vanquish such a formidable foe as a cat or a snake. When attacking, she jumps and strikes the enemy with her hind feet—members capable of a powerful blow, as many a boy who has captured a live rabbit can testify.

Young rabbits are attended and suckled in the nest for about three weeks, after which they are left to shift for themselves. Since usually succulent food is abundant, this is not a difficult task, and, subject to the vicissitudes of climate and the attacks of natural enemies, they soon adapt themselves to an independent life. Apparently the mother takes no further interest in the career of her offspring. The male parent is probably never concerned in the care of the young.

FOOD OF RABBITS.

Rabbits are strict vegetarians, animal food never being eaten by the adults. They eat all sorts of herbage—leaves, stems, flowers, and seeds of herbaceous plants and grasses, and leaves, buds, bark, and fruit of woody plants or trees. The most succulent kinds, such as young shoots, tender garden vegetables, clover, alfalfa, and fallen ripe fruits, are generally preferred; but when these fail, any green vegetable growth seems acceptable, and the bark of trees is often resorted to when deep snows cover other supplies or during long summer droughts.

The common cottontail is fond of frequenting farms and plantations and makes its " forms " under brush heaps or in tufts of grass, bunches of weeds, briers, or bushes (Pl. XXXVII). It occupies this form, or nest, by day and at night moves about, feeding upon the succulent vegetables in the farmer's garden, or the clover, turnips, or corn in his fields. In the fall it feasts upon apples, cabbages, turnips, and the like left exposed in garden and orchard, and in winter, when all else is frozen hard or covered with snow, it turns its attention to twigs and bark of woody plants, often doing much damage to young trees.

The other species of rabbits have similar habits, varying with the environment of the animals. In the West some of the smaller kinds live largely in the abandoned burrows of prairie dogs, badgers, and other animals.

INJURY TO FIELD CROPS.

Rabbits feed upon nearly all growing crops, but the damage to small grains is usually so slight as to pass unnoticed. Wheat and rye afford abundant pasture for rabbits during open winters, and this without apparent effect upon the yield of grain. Rabbits eat very little mature grain, except corn in winter, and this is but seldom damaged as long as green herbage can be obtained.

Clover and alfalfa are favorite foods with all our rabbits, and these crops are badly damaged by them. In the West alfalfa is the principal forage crop over considerable areas, growing often amid arid surroundings. It is green throughout the greater part of the

year, and thus furnishes a rich, succulent, and attractive food for the cottontail and jack rabbits. Where an alfalfa patch is isolated, like a small oasis in a desert, rabbits sometimes keep it pastured down, so that little if any forage can be cut. Besides eating the plants, the animals keep well-worn paths beaten through the fields.

On open western ranges, ordinarily, the rich native grasses, though often of sparse growth, furnish ample food for rabbits; and when the animals are numerous the amount of pasturage available for stock is considerably reduced. In the Southwest rabbits often eat the juicy pulp in the pads of the prickly pear (*Opuntia*) and the bark and twigs of the mesquite (*Prosopis*), and during long droughts they subsist largely upon these plants.

In the West and Southwest rabbits are destructive to watermelons and cantaloupes, eating the young plants as well as the fruit. At Laredo, Tex., H. C. Oberholser, of the Biological Survey, observed that jack rabbits had ruined an entire field of cantaloupes when the plants were about 6 inches high, and had greatly damaged a field of watermelons. At Seguin, Tex., in November, 1904, Vernon Bailey found that about 75 per cent of the watermelons in one field had been destroyed by jack rabbits, and that cantaloupes could not be grown except when protected by rabbit-proof fences.

INJURY TO GARDENS.

Rabbits are fond of nearly all garden vegetables, but are particularly partial to peas and cabbages, eating the plants at all stages of growth, especially when small. They often invade market gardens and truck patches near towns and do much damage. Formerly, when there were few restrictions on the hunting of rabbits, boys and dogs usually kept down the numbers of the animals so that they interfered but little with market gardening. With the very short open season for rabbit shooting now provided in some States and a constantly growing tendency everywhere to "post" lands against trespassers, damages by the animals have become more serious, and truck farmers are more and more compelled to resort to close fencing as a protection.

INJURY TO TREES.

Rabbits injure trees and shrubs in two ways—by cutting off the ends of branches and twigs within reach, and by eating the bark. Young nursery trees and forest seedlings, both evergreen and deciduous, are destroyed in the first way; while orchard and larger forest trees are badly damaged and often killed in the second way. When the trunk of a tree is attacked, the injury begins at a height of from 8 to 16 inches from the ground. The large incisors of the animals cut into the bark laterally from both sides, and a strip of bark is torn away. This is repeated until large areas of wood are

EASTERN COTTON-TAIL RABBIT (LEPUS FLORIDANUS MALLURUS).

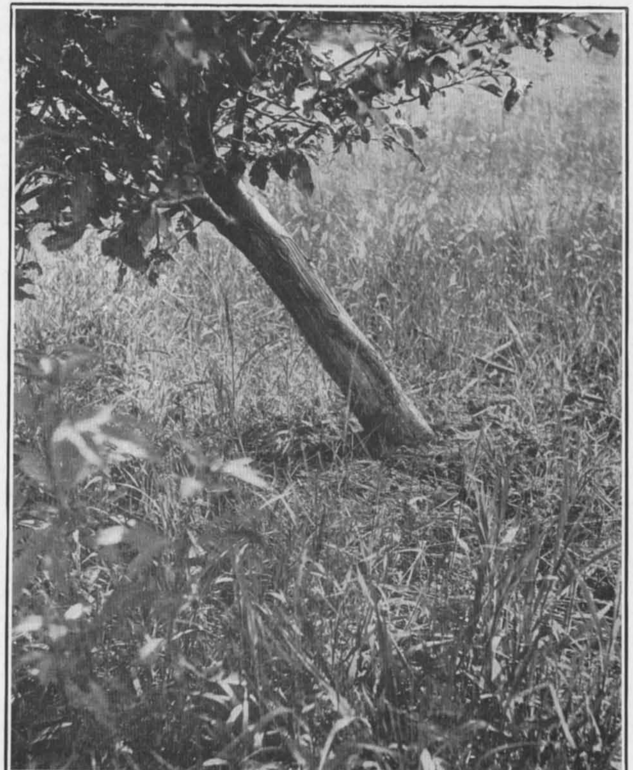

FIG. 1.—APPLE TREE INJURED BY RABBITS.

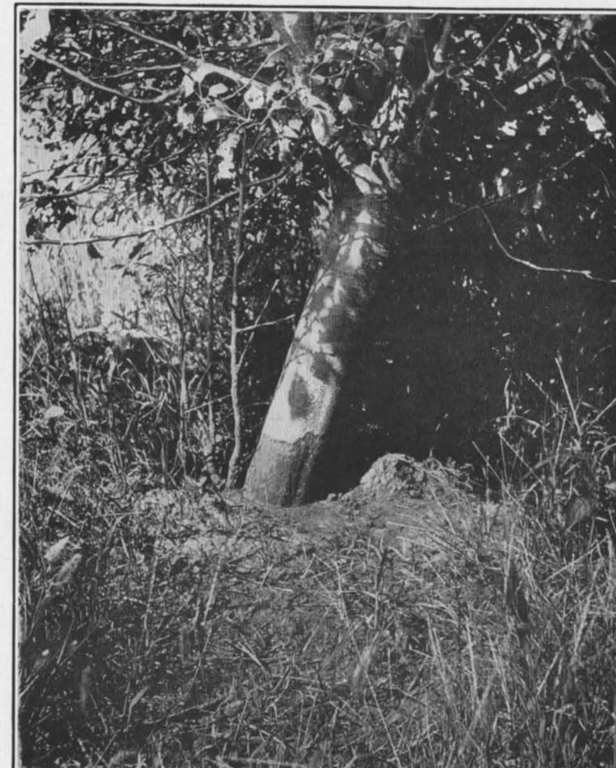

FIG. 2.—APPLE TREE INJURED BY MEADOW MICE.

uncovered, often until the tree is entirely girdled. The difference between the work of rabbits and that of field mice may easily be detected by the large tooth marks of the former and by the tearing of the bark in strips. The work of mice usually begins at or below the surface of the ground, and the fine tooth marks cover the entire surface that is denuded of bark. Mice, like rabbits, also sever twigs, but the tooth marks are small. In spite of these constant and obvious differences, many orchardists attribute to rabbits much of the damage done by mice. (Pl. XXXVIII, figs. 1 and 2.)

A list of the trees and woody shrubs whose twigs and bark are eaten by rabbits would include a large majority of our arborescent plants. Whether certain trees, like the walnut for instance, are absolutely exempt from attack is an open question. Usually the apparent immunity of a tree from the attack of rabbits is to be taken as indicating that other trees growing near it are preferred; for when an entire plantation is of a single species, its apparent immunity often disappears. Thus the incense cedar (*Libocedrus decurrens*) of California, long reputed to be exempt from attacks by rabbits, when planted by the Forest Service in the San Gabriel National Forest was badly injured by cottontail rabbits.

Newly planted orchards in most sections of the United States are liable to injury from rabbits, and few are now set out without provisions for winter protection from these animals.

INJURY TO NURSERIES.

In many parts of the country nurseries of young fruit, forest, and ornamental trees and shrubs are subject to injury from rabbits. In some instances nurserymen report losses of from 20 to 30 per cent of their stock in a single winter, the money value reaching several thousand dollars. The losses of orchard and nursery stock in one neighborhood in Arkansas during the comparatively mild winter of 1905–6 were estimated at fully $50,000. Similar reports come from other sections. In some States the losses of nursery stock from rabbits undoubtedly are increasing from year to year.

RABBITS IN FOREST PLANTINGS.

In Europe young forest plantations are often injured by rabbits. On the Plains of our own country, under the operation of the old timber-culture act, rabbits sometimes proved to be almost as formidable obstacles to success as drought. The Forest Service is making important progress in the work of forest extension. This work, both in cooperative and reserve plantings, is often hampered by depredations of rabbits, especially in wild country partly covered by dense chaparral, which harbors the smaller species. Depredations have been so extensive as to indicate that rabbits, both cottontails and the

larger species, are likely to prove a serious hindrance to the work of forest extension.

THE RABBIT AS GAME.

The smaller American rabbits have long been esteemed as game. While their flesh is less tender than that of the domesticated species (Belgian and other races), it is of much finer flavor, and when properly prepared for the table is much more desirable as food. With the same care in dressing and handling bestowed upon the rabbit in English markets, our cottontail rabbit would stand much higher in popular flavor. The jack rabbits of the western Plains are not so good, the flesh, except in young animals, being somewhat coarse and dry; yet many reach our markets.

The trade in rabbits is extensive, since there are few restrictions upon their sale. They are usually both abundant and cheap, and furnish an excellent substitute for higher-priced game. Unfortunately, on account of their cheapness, little care is taken in handling and dressing them for market, and for this reason many people refrain from buying them for the table.

In the South there are few restrictions on hunting rabbits, and they can be obtained at almost any time. As a valuable source of food for the people of this section, the rabbit is of considerable economic importance.

PROTECTIVE LEGISLATION.

The manner in which the rabbit is regarded by the people of the various States is well shown by the existence or the absence of laws for its protection. In the New England and the Middle Atlantic States the rabbit is protected, while throughout most of the West and South no restrictions are placed on hunting the animals. In some Western States they are regarded with such disfavor that bounties have been paid for their destruction. In States where they are most abundant, protection is rarely afforded. In sections of the country where a close season on rabbits is accompanied by a strict enforcement of laws against trespass by hunters, rabbits have often become so abundant that farmers have asked for a repeal of the protecting laws.

Sixteen States have laws fixing a closed season for rabbits, and in the District of Columbia, in addition to the closed season, all shooting is prohibited. Kentucky prohibits the hunting of rabbits for a short time just previous to the open season for quail, the object being to protect the birds rather than rabbits. The list on the following page shows the States which have laws for the protection of rabbits.

Length of open season for rabbits in States which limit the time for hunting them.

	Length of open season.[a]
Maine	September 1 to April 1—7 months.
New Hampshire	October 1 to April 1—6 months.
Vermont	September 15 to May 1—7½ months.
Massachusetts	October 1 to March 1—5 months.
Rhode Island	November 1 to January 1—2 months.
Connecticut	October 1 to December 1—2 months.
New Jersey	November 10 to January 1—52 days.
New York (28 counties [b])	Two to five months.
Pennsylvania	October 15 to December 1—1½ months.
Delaware	November 15 to January 1—1½ months.
District of Columbia	November 1 to February 1—3 months.
Maryland	November 1 to December 25 [c]—54 days.
Virginia	Two to six months.[d]
West Virginia	September 15 to January 1—3½ months.
Ohio	November 15 to December 5—20 days.
Wisconsin	September 1 to March 1—6 months.

In Ohio, where the open season is only twenty days, there is much complaint from nurserymen of loss of trees from rabbit injury. At the meeting of the State Horticultural Society, in 1897, prominent nurserymen and market gardeners complained of rabbit depredation, which seemed to be great in the neighborhood of the larger towns.[e]

It is probable that, except where the open season is very short, protection has but little effect upon their numbers. Ordinarily the animals are at their best for food during the fall and winter months, and there is a prejudice against eating them during the breeding season. Besides, during the spring and summer they are subject to parasites which often make them unfit for food.

THE FARMER AND RABBIT PROTECTION.

The relation of the farmer to rabbit protection is rather complicated. As a rule he regards the animals as pests and is glad to have them killed, especially in the open fields; but often those engaged in the nursery business or in growing small fruits, as well as those having farm animals in pastures, object to hunting upon the premises, and therefore must depend upon their own efforts to free their holdings from rabbits. The task is the more difficult because during the shooting season their premises, if protected, become harbors for the persecuted rabbits of neighboring estates.

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[a] The open season includes the first day given but not the last.

[b] No closed season in other counties.

[c] A few local exceptions.

[d] Local laws apply to the various counties.

[e] Cultivator and Country Gentleman, 62, p. 1026, 1897.

MEANS OF REPRESSION.

When rabbits so increase in numbers as to become a menace to crops, repressive measures become necessary, and under these circumstances the operation of such measures should not be restricted to the open season. Laws should be so modified as to permit the farmer to protect his crops by destroying rabbits upon his own premises whenever necessary. Several States already have such provisions; others do not, although permitting the orchardist to destroy insectivorous or other birds that attack his fruit, and a similar privilege in the case of a recognized pest such as the rabbit should certainly be granted.

NATURAL ENEMIES.

Among the agencies that help to destroy rabbits none are more effective than carnivorous birds and mammals. These include large hawks and owls, eagles, wolves, coyotes, lynxes, foxes, minks, weasels, and domestic dogs and cats. The list of our birds of prey known to feed upon rabbits includes the marsh hawk (*Circus hudsonius*), the Cooper hawk (*Accipiter cooperi*), the goshawk (*Accipiter atricapillus*), the Harris hawk (*Parabuteo unicinctus harrisi*), the red-tailed hawk (*Buteo borealis* and subspecies), the red-shouldered hawk (*Buteo lineatus*), the Sennett white-tailed hawk (*Buteo albicaudatus sennetti*), the Swainson hawk (*Buteo swainsoni*), the rough-leg (*Archibuteo lagopus sanctijohannis*), ferruginous rough-leg (*Archibuteo ferrugineus*), the golden eagle (*Aquila chrysaëtos*), the bald eagle (*Haliætus leucocephalus*), the long-eared owl (*Asio wilsonianus*), the short-eared owl (*Asio accipitrinus*), the barred owl (*Syrnium varium*), the great horned owl (*Bubo virginianus*), and the snowy owl (*Nyctea nyctea*). Other smaller hawks and owls sometimes destroy young rabbits. The large species, as the eagles, the horned owl, and the buzzard hawks (*Buteo*), are the ones that prey most upon rabbits. Unfortunately, in many sections where they are needed, these birds year by year are being ruthlessly killed and are becoming rarer. With certain exceptions the same may be said of the wild mammals that destroy rabbits.

HUNTING THE RABBITS.

On the whole, in America hunting has been the most effective means for keeping down the number of rabbits. In some parts of the country this method was carried so far that lovers of the sport were compelled to invoke legislation to protect the rabbit from extermination.

As to methods of hunting, shooting is generally preferred. Ferreting usually is impracticable, since few of our native rabbits take refuge in burrows. Moreover, the use of ferrets is forbidden by law in some States which protect the rabbit. Coursing with greyhounds

has many advocates and is popular in the West, where the swifter jack rabbits abound. Smaller rabbits are often chased with foxhounds, but the beagle is rapidly taking precedence as a favorite for rabbit hunting, the gun being depended upon for securing the game.

RABBIT DRIVES.

Where the country is sufficiently open for the purpose, one of the most successful methods of reducing the numbers of rabbits is the organized hunt, known as the "drive." This method has been tried in many localities in the West and in Australia with satisfactory results, the number of rabbits killed in a single drive reaching as high as 10,000 or even 20,000.

TRAPPING THE RABBIT.

Rabbits are easily trapped and snared, and these methods of destruction although slow are always available in wood lot, orchard, nursery, field, or garden. Many of the animals are caught in box traps set with a figure-four trigger, with cord attached to hold up the box lid.

An improvement upon these old-fashioned box traps is widely used in the Central West. In Kansas and Missouri it is familiarly known as the "Wellhouse" trap, it having been used extensively in the large orchards owned and controlled by Mr. Fred Wellhouse, of Topeka, Kans. This trap is not patented, and is not on the market, but can easily be made by any farmer. The trap is a box made of 6-inch fencing boards, old ones being preferred. The box is about 21 inches long, closed at the back by a board, but in front by a wire door only. The door is hung from the top and swings inward. A cleat at the bottom prevents its opening outward. The trap is set and the wire door is kept open by a wire trigger-rod, held in place by two staples fastened to the top of the box. This trigger is bent downward near the rear of the trap and formed into a loop or a figure eight. As the rabbit enters the trap and crowds into the back part, it pushes upon the loop, moves the trigger wire backward, and releases the wire door. This falls and makes the rabbit a prisoner. Bait may be used, but is not necessary, since the cottontail is constantly looking for dark places to hide from enemies or cold winds. Mr. Wellhouse uses about three traps per acre in young orchards and many among the bearing trees. They are regularly looked after by boys, and so effective have they proved that no serious losses from rabbits have occurred in his orchards.

The materials needed for making a Wellhouse trap are: Four boards 1 by 6, 21 inches long; one piece 1 by 6, 8 inches long for the back; a short cleat for the door stop; 28½ inches of wire to serve

for the door; 22 inches of wire for the trigger; four small staples for hanging the door and trigger; and nails. (See fig. 34.)

POISONING RABBITS.

In the West, poison for destroying rabbits has been resorted to with some success. The most favorable season for its use is in winter, or after long-continued drought has made green food scarce. In summer and early autumn grasshoppers and crickets interfere greatly with poisoning operations by consuming the baits put out for rabbits. The methods of poisoning rabbits here given are the ones best adapted for general use: Crystals of strychnia sulphate may be inserted in ripe prunes, pieces of melon rind, or apples, and these placed at intervals along rabbit runs or paths, care being taken to put them where children and domestic animals do not have

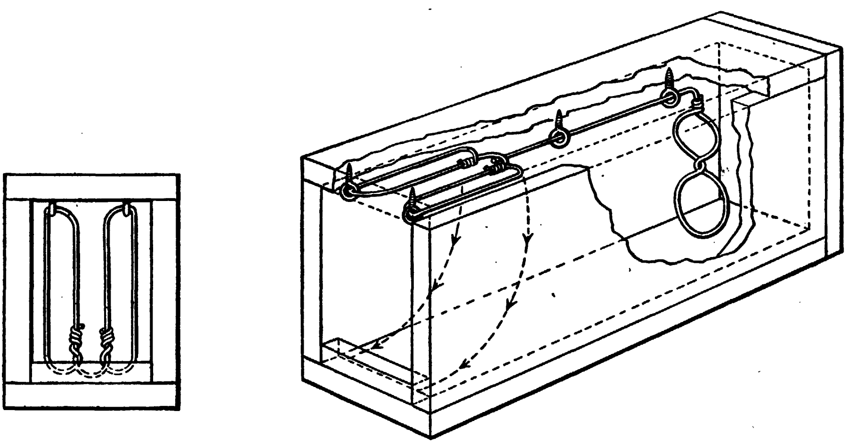

FIG. 34.—Details of Wellhouse rabbit trap.

access to them. Where no well-defined runs are visible in orchards, artificial ones may easily be made with a drag or with a one-horse scraper. Along such runs or the dead furrows of plowed fields rabbits habitually travel. The prepared baits may be placed on the ground or elevated on short sticks at intervals along the path. Baits should be looked after with care, and if any are left after poisoning operations are over they should be destroyed.

When grasshoppers are not numerous oatmeal soaked in a well-sweetened solution of strychnia is an excellent bait for rabbits. During seasons of drought, poisoned water has been used successfully to destroy rabbits. Water containing arsenic or strychnine is placed in shallow vessels and exposed along the runs. This method has been practiced in Australia, but the danger of poisoning birds is a serious objection, unless the poisoned water is put out at dark and removed or covered at daylight.

Rabbits may be poisoned in winter by baiting with twigs cut from apple trees and dipped in a solution of strychnine and sugar. These baits are scattered along rabbit paths and in cold weather are very effective. This method has the merit of being without danger to birds or other animals except rabbits or field mice.

The carcasses of poisoned rabbits, when found, should be buried, and every precaution should be taken to prevent the accidental poisoning of other animals or human beings.

PROTECTION OF CROPS FROM RABBITS.

Complete extermination of rabbits in any part of the United States is not desirable, even were it possible. They should be reduced in numbers far enough to secure safety to crops; and before active wholesale destruction of the animals is attempted, the possibility of crop protection should be carefully considered. In many cases protection would probably be the more economical method. All known methods of destroying rabbits are expensive. This was well illustrated by the experience of the Australian colonies in dealing with the rabbit problem. Thus in New South Wales, when some 2,000 men were constantly employed in the work of destruction, the number of rabbits killed per month was upward of 600,000, but the cost was enormous. When the total of rabbits killed amounted to 7,853,787, the sum paid out for the work was about $1,757,000, or more than 22 cents for each rabbit.[a] Unless the cost can be reduced much lower than this, protection of crops is far cheaper.

RABBIT-PROOF FENCES.

When rabbits are abundant and the area to be protected is not too great, a rabbit-proof fence may be profitably employed. Woven wire nettings are generally used for this purpose. In the Australian colonies such fences are erected by the Government to confine rabbits to certain districts, as well as by private owners to protect crops. As the Australian pest is a burrowing species—the European rabbit (*Lepus cuniculus*)—the requirements for a rabbit-proof fence differ from those necessary in this country. Even with our species there is some danger of their digging under fences, and this may be prevented either by the use of a barbed wire in contact with the ground or by plowing a furrow against the lower edge of the wire netting. A netting of galvanized wire with 1½-inch mesh and from 2 to 3 feet high is a sufficient barrier against rabbits. Many market gardeners and nurserymen use the 2-foot width; others prefer a netting 2½ feet wide, and, turning the lower edge outward

[a] Sydney Morning Herald, quoted in Cultivator and Country Gentleman, 52, p. 628, 1887.

from 4 to 6 inches, cover it with soil. Netting made of No. 20 wire costs from 20 to 30 cents per rod. Heavier netting slightly increases the cost of fencing, but adds to its durability. Where lumber is cheap, a picket fence or one made of pickets and wire combined may be substituted for the netting.

TREE PROTECTION.

The devices that have been recommended for protecting trees from rabbits are too numerous for separate mention. The majority consist of paints, washes, or smears of various kinds, supposed to be distasteful to the animals. Unfortunately, those that are sufficiently permanent to afford protection for an entire winter often injure or even kill the trees to which they are applied. Coal tar, pine tar, tarred paper, and various oils are likely to kill young trees. Blood and animal fats when freshly applied will protect from rabbits, but are objectionable, since they are highly attractive to the destructive short-tailed field mice. Carbolic acid and other volatile substances afford only temporary protection, and must be renewed too often to justify their use. Bitter substances, like commercial aloes, or quassia, are useless against rabbits.

Among the most promising washes that have been recommended for tree protection is the "lime-and-sulphur" wash, so effective in winter for the destruction of the San Jose scale. Several correspondents of the Biological Survey have affirmed its efficacy in protecting trees from both mice and rabbits. If this cheap method of controlling our worst insect pest of the orchard has further value in protecting trees from rodents, the fact can not be too widely advertised. The results of personal observation by the writer seem to fully warrant its recommendation, and its cheapness makes the method worthy of general trial by orchardists.

The formula for the wash, reduced to the basis of the capacity of the ordinary kerosene barrel commonly used in the preparation, is:

Unslaked lime	pounds	20
Flowers of sulphur	pounds	15
Water to make	gallons	45–50

A little salt may be added to increase the adhesive property of the mixture. The lime, sulphur, and about a third of the water are boiled together for at least one hour, and the full quantity of water is then added. For San Jose scale the wash in the form of a spray is applied to the entire surface of the trees. For protection from mice and rabbits the trunks only require treatment, and the wash may be applied with a brush. One application in November should last the entire winter.

Mechanical contrivances for protecting young orchard trees are many. Where protection from rabbits only is required, woven wire netting is recommended. This should be made of No. 20 galvanized wire, 1-inch mesh, such as is often used for poultry netting. For cottontail rabbits rolls 18 inches wide are recommended, but as a protection against jack rabbits wider material is safer. The wire is cut into 1-foot lengths, and one of these sections is rolled into shape about the trunk of each tree, the ends being brought together and fastened at several places by means of the wire ends. No other fastening is needed. The wire is not in contact with the trunk and may be left on the tree permanently. It will probably last as long as the tree requires protection, and the cost of material need not be over $1\frac{3}{4}$ cents for each tree. For young evergreens, material of the same kind 1 foot wide and cut in $1\frac{1}{2}$-foot lengths will give excellent protection.

If trees are to be protected from both rabbits and mice, materials of closer mesh must be used. Wire window-screen netting is excellent for the purpose, and the cost, when permanence of protection is considered, is not great.

Veneer and other forms of wood protectors are popular and have several advantages. When left permanently upon the trees, however, they furnish retreats for insect pests. For this reason they should be removed each spring and laid away until cold weather. While the labor of removing and replacing them is considerable, they have the advantage, when pressed well into the soil, of protecting from both mice and rabbits. They cost from 60 cents per hundred upward, and are much superior to building paper or newspaper wrappings. The writer has known instances where rabbits tore wrappings of building paper from the apple trees and in a single night injured hundreds of them. "Gunny-sack" and other cloth wrappings, well tied on, are effective protectors. Cornstalks also furnish a cheap material for orchard protection. They are cut into lengths of 18 to 20 inches, split, and tied with the flat side against the tree, so as fully to cover the trunk.

Few of these methods for the protection of individual trees in orchards or elsewhere are applicable to young woodlands or forest plantations where trees grow close together. In such cases the only remedy is destruction of the animals or their exclusion by wire nettings.

Clean cultivation, generally, has some advantages in preventing rabbit depredations, since it reduces the number of places of refuge for the animals; but rabbits go long distances in search of food, especially in winter, and clean cultivation can not be applied on the western plains, where dense wind-breaks are essential to successful orcharding.

Feeding rabbits in winter to prevent attacks upon orchards has been successfully practiced, on the theory that it is cheaper to feed than to fight them. One plan is to leave the winter prunings of apple trees scattered about the orchard. Another is to furnish corn, cabbage, or turnips in sufficient quantities to feed the rabbits during cold weather. These methods have considerable merit, particularly the former, which seems to give excellent results when both mice and rabbits are present.

THE STATUS OF THE AMERICAN LEMON INDUSTRY.

By G. HAROLD POWELL,

Pomologist in Charge of Fruit Transportation and Storage Investigations, Bureau of Plant Industry.

INTRODUCTION.

The American lemon industry has become permanently established on a firm foundation within the last few years, the seasons since 1904 having proved unusually profitable. It commenced to assume a commercial aspect twenty-five years ago, but for a score of years it was a question whether it would become established permanently or whether the American supply of lemons would continue to be derived, as in the past, from foreign sources.

The lemon is grown in the citrus-fruit belt of California, where at the present time the annual production is from 3,000 to 4,000 carloads, which represents approximately 100,000,000 pounds, or from one-third to two-fifths of the total quantity used in the United States. There are imported annually into the United States about 150,000,000 pounds of lemons, mostly from the island of Sicily. If this amount of fruit were expressed in terms of the California method of packing and shipping it would represent more than 1,750,000 boxes, or about 6,000 carloads.

In the early days of the industry there were no precedents to follow that were applicable to the handling of the lemon in California. The pioneer growers made many mistakes. Each step forward in the culture of the groves and in the handling and shipment of the fruit was gained by costly experience. Groves were located in unsuitable places, on frosty areas, on uncongenial soils, in localities dependent upon an inadequate supply of irrigation water, or on soil that was overcharged with alkali. The growers had to learn about the handling of the soil, the irrigation and fertilizing of the crop, and the maintenance of soil fertility by cover crops and other sources of humus. The methods of pruning have only recently begun to emerge from a chaotic condition. The losses from decay until recently were so large and so universally expected that the California lemon was generally supposed to have poor keeping qualities, and dealers were cautious about handling the fruit. The industry became so depressed that ten years ago many of the groves were top-worked to oranges.

These conditions, however, are gradually changing. The California lemon growers are men of the highest intelligence and are in close touch with the developments of agricultural science. They are continually learning more about the requirements of the soil and of the trees. They handle the fruit with more care and skill than is bestowed on any other orchard crop of this country, and are developing successful methods of curing and of holding the fruit. The decay in lemons that are handled properly is a less important factor than formerly. The most critical dealer and the consumer both have confidence in the best brands of the fruit. An energetic, organized marketing policy has replaced the former unsatisfactory methods of disposing of the fruit. Special concessions in freight rates have been made by the railroads as a stimulus to the industry, and the most difficult problems of culture, of handling, and of shipment that are not well understood are being studied by State and Federal investigators in cooperation with some of the most progressive growers and shippers.

As a result of the recent progress in the industry, the demand for the best brands of California lemons is greater than the present supply. The area of groves is extending considerably, though more slowly than the growers desire, as the nurserymen have not been able to supply the demand for trees during the last two or three years, their propagation having been almost abandoned when the business was in the most depressed stage. At that time trees were sold at 10 to 20 cents apiece, but in the winter and spring of 1907, following three years of unusually high profits, all available trees in the State were sold at prices ranging from 75 cents to $1.50 each. It will be several years before the product of the recent plantings increases the total supply of fruit to any considerable extent.

THE LOCATION OF THE AMERICAN LEMON INDUSTRY.

The American lemon industry is located principally in southern California, which includes the counties south of the Sierra Madre Mountains. The most important region north of these mountains is in Tulare County, where the present annual production reaches about 150 carloads. The lemon groves are scattered along the foothills of these mountains and into the valleys from the coast at Santa Barbara inland to Riverside and Redlands. There are large plantings on the foothills of the Temescal Range at Corona. Along the coast the plantings are scattered here and there from Santa Barbara to the Mexican line, the so-called coast region including an area extending 20 miles or more inland. There are large plantings inland in San Diego County and along San Diego Bay, especially at National City and Chula Vista. The important regions, with their approximate production during the season from November 1, 1906,

to October 31, 1907, may be roughly grouped as follows: Tulare County, 150 cars; Santa Barbara and Ventura counties, including Santa Barbara, Fillmore, and Santa Paula, 475 cars; the San Dimas center, including Duarte, Azusa, Covina, Glendora, San Dimas, Pomona, and Claremont, 380 cars; the Upland, Ontario, and Cucamonga region, 260 cars; the upper San Bernardino region, including Riverside, Rialto, Colton, Redlands, East Highlands, and near-by places, 470 cars; the Corona region, 570 cars; the Los Angeles region, including Whittier, Lamanda, Fernando, Pasadena, and Hollywood, 440 cars; Orange County, 110 cars; San Diego County, 800 cars; making 3,505 carloads from southern California and 150 carloads from Tulare County.

The lemon-growing sections in southern California are generally spoken of as the coast and inland regions, though there is no well-defined line between them. The altitude of the coast region varies from sea level to 200 or 300 feet. The inland regions range from 750 to 1,250 feet in altitude. The climate of the lemon belt, like the climate on the Pacific coast generally, presents the widest variation within a comparatively small area. In general, however, the climate of the coast is more equable than that of the inland region, the annual mean temperature averaging a little lower and more uniform and the relative humidity higher and also more uniform. The fruit of the coast region is more uniform in texture and in ripening throughout the season; it has a little thinner skin, and the largest part of the crop matures comparatively later in the spring. It has been commonly supposed that the lemons from the coast have poorer keeping quality than the interior-grown lemons, but it is a question whether this difference exists in fruit that is handled with equal care. It has also been supposed that the best coast lemons are produced not in close proximity to the ocean, but from 16 to 20 miles inland; but this, too, is open to question. The scale insects thrive more abundantly in the moister air of the coast, though fumigation or spraying has to be practiced in nearly all sections to hold the insect pests in check.

THE IMPORTS OF LEMONS INTO THE UNITED STATES.

The lemons imported into the United States are grown principally in Italy, the fruit coming mainly from May to September from the island of Sicily, with a small quantity from the vicinity of Naples. A few lemons are imported from Spain, Mexico, and the West Indies. The industry is being developed to a limited extent in Cuba and Porto Rico. A duty of 1 cent a pound is assessed on imports of lemons, except from Cuba, on which the duty is 20 per cent less. The imports of lemons are not increasing and there is considerable difference in the quantity imported from year to year, depending on the

condition of the American markets and the crop abroad. The Sicilian fruit is received in packages of various sizes, the bulk of it coming in boxes containing 300, 360, or 420 lemons each. Efforts are being made by American receivers to restrict the imports to a standard size of box measuring 26⅝ by 13⅛ by 10⅝ inches, outside measurement, for the 360-lemon size. The demand for the lemon, in common with other fruits, is increasing throughout the country, especially in the growing Central West and West, but the increased demand is supplied to a large extent by the California fruit.

The imports of lemons into the United States for the fiscal years 1900 to 1907, inclusive, are shown in the following table. In order to furnish a basis of comparison between the imports and the domestic production, there is included in the table a statement of the number of boxes and carloads of imported fruit expressed in terms of the standard California box of 84 pounds and of 312 boxes to the car.

Importations of lemons for the fiscal years 1900 to 1907, inclusive.

Year.	Pounds.	Equivalent number of boxes of 84 pounds each.	Equivalent number of carloads of 312 boxes.
1899–1900	160,198,056	1,907,119	6,112
1900–1901	148,514,614	1,768,031	5,666
1901–2	164,075,309	1,953,277	6,260
1902–3	152,004,312	1,809,575	5,799
1903–4	171,923,221	2,046,705	6,559
1904–5	139,084,321	1,655,765	5,306
1905–6	138,717,252	1,651,395	5,292
1906–7	157,859,906	1,879,284	6,023

There are imported into the United States citrus by-products in large quantity, of which the lemon and the lime form the principal source, but the commercial manufacture of which has not yet developed to any considerable extent in this country. Imports of lemon oils—volatile, or essential, or distilled—chiefly used for flavoring; citric acid from lemons and limes for pharmaceutical use; citrate of lime; lemon and orange peel; and lemon, lime, and sour-orange juice amounted in 1906 to nearly $900,000.

THE SHIPMENTS OF LEMONS FROM CALIFORNIA.

The citrus-fruit shipments from California include oranges, lemons, and pomelos or grape-fruits. The statistics of the shipments were grouped together as a whole until a few years ago. At the present time the railroads endeavor to keep the statistics of the orange and lemon shipments separate, though the shipment of mixed cars of citrus fruits and of cars of different sizes makes it difficult to obtain statistics that are more than a close approximation of the shipments. There are two sizes of refrigerator cars used in the shipment of

lemons—the 36-foot car, which holds 288 boxes, and the 40-foot car, which holds 312 boxes—though most of the fruit is shipped in the larger cars. The fruit is usually forwarded under ventilation from November to March, and under ice during the remainder of the year. Some of the shippers who handle the fruit with extreme care use the ventilation method of shipment throughout the season. The minimum freight weight at the present time for a carload of lemons is 24,190 pounds for cars 37 feet or less in length, outside measurement, and for cars over 37 feet in length, 26,200 pounds. There is a blanket freight rate of $1 per hundred pounds in carload lots to the principal points in the United States, with a rate of $1.25 per hundred pounds to certain points in the Northwest, and a rate varying from $1.25 to $1.40 to points in the southeastern part of the country. The rate on lemons shipped under refrigeration is based on the section of the country into which the car is shipped and the weight of the fruit in the car. The rate to Chicago, for example, on a car of 24,190 pounds is $54.67, and to New York, $65.61. On a car of 27,650 pounds the rate to Chicago is $62.50 and to New York $75. The standard lemon box has an outside measurement of 11 by 14½ by 27 inches and is estimated in shipment to weigh 84 pounds. It is divided in the center by a partition. The shipping season is considered to begin November 1 and to end October 31 following. The following table gives a record of the carloads of lemons shipped from southern California since 1897, as compiled by the Pacific Fruit World, December 15, 1906. The table includes also a statement of the number of boxes, based on 312 boxes to the car, and a statement of the number of pounds of fruit, based on an estimated weight of 84 pounds per box. The statement in pounds makes it possible to compare in a general way the quantity of lemons shipped from California with the quantity of lemons imported into the United States.

Shipments of lemons from southern California from 1897 to 1907, inclusive.

Year.	Cars.	Estimated number of boxes (312 per car).	Estimated number of pounds (84 pounds per box).	Year.	Cars.	Estimated number of boxes (312 per car).	Estimated number of pounds (84 pounds per box).
1897–98	1,166	363,792	30,558,528	1902–3	2,649	826,488	69,424,992
1898–99	903	281,736	23,665,824	1903–4	2,782	867,984	72,910,656
1899–1900	1,447	451,464	37,922,976	1904–5	4,274	1,333,488	112,012,992
1900–1901	2,924	912,288	76,632,192	1905–6	3,789	1,182,168	99,302,112
1901–2	2,816	878,592	73,801,728	1906–7 [a]	3,507	1,094,184	91,911,456

[a] Pacific Fruit World, November 2 and November 9, 1907.

THE DISTRIBUTION OF LEMON SHIPMENTS THROUGHOUT THE YEAR.

The lemon is shipped from California every month of the year. The distribution is regulated somewhat by holding the fruit picked in winter and spring in common storage for several weeks or months

before shipment. The lemon tree when handled properly is ever bearing, a tree containing at any time fruit in all stages of development from the blossom to the ripe lemon. The fruit ripens most abundantly during the late fall, winter, and spring, the heaviest harvest occurring from February to June in the coast region and beginning in November and December in the inland regions. It is the aim of the lemon grower to have the harvest as heavy as possible in the summer, when the fruit is in greatest demand, and he endeavors to influence the season of bearing to some extent by pruning and by irrigation, though not to the extent attempted by foreign lemon growers. The most profitable months in the lemon market are during hot weather from May to September, the condition of the market at any time during this period depending on the temperature at the point of consumption and the supply of imported fruit. The shipments from California are largest from March to July, about 60 per cent of the crop going forward during that period. The shipments in the last few years have been greatest in the months of May, June, and July. The fruit shipped in the spring and summer may include winter and spring lemons that have been stored, as well as the fruit that is picked during the spring and summer months.

THE DISTRIBUTION OF LEMON SHIPMENTS THROUGHOUT THE COUNTRY.

The California lemon is shipped principally into the markets of the Central West and West. In the territory west of the Missouri River, including central and western Texas, the trade is supplied almost exclusively with the California fruit. In the Middle West, especially in the territory north of the Ohio River, probably from 40 to 50 per cent of the lemons used are from California. In the Southern Central States, including eastern Texas, the trade is supplied largely with imported fruit distributed from New Orleans. The California fruit has not been marketed extensively in the Atlantic seaboard markets, as the crop is not yet large enough to furnish a regular supply for all the markets of the country throughout the spring and summer. Considerable fruit is sent to eastern points in the fall and early winter, when the first shipments of the new crop are ready to move, and at other times when the demand is lighter than usual in the markets of the Central West. The increase in demand for the fruit in the western half of the country has fully kept pace with the increase in production in California. There is also considerable California fruit sold in western Canada, and lesser quantities in central and eastern Canada. There is an increasing demand for the California lemon in the East, where the importers have heretofore had control of the market. The trade is beginning to appreciate the quality of the California fruit, the standard size of the package, and the uniformity of its pack, the

packages and packing of imported lemons having long been subjects of general criticism among the trade. The eastern trade will continue to secure its supply of fruit from foreign sources for some time, but as the younger groves come into bearing and produce sufficient fruit to exceed the demands of the West and Central West, the California lemon will become an increasingly important factor in the markets of the East.

THE MARKETING OF CALIFORNIA LEMONS.

The California lemon is marketed largely through cooperative fruit growers' associations or by the individual growers and corporations that produce the fruit. It is practically impossible for the owner of a small grove to market his own fruit. From 75 to 80 per cent of the fruit is handled by cooperative associations or by extensive individual growers or corporations. The remainder of the crop is sold for the growers by packers and shippers, either f. o. b. in California or in a distant market, or it may be purchased by a dealer either by the pound or by the box. It is bought occasionally in lump on the trees, the purchase to cover all fruit picked within a stated period of time. The fruit is sold in the eastern markets through agents of the associations or fruit dealers, by commission merchants, or at public auction.

The fruit is shipped under brands that are established by the shippers and which represent the different grades of lemons. The fruit is usually sorted into two or three, and sometimes into four, grades. The grading of the lemon is based on the general texture of the skin, on the appearance as influenced by scars, on the color, and on the form and general style of the fruit. The grade has no reference to the size of the lemon. The highest grades are those in which the fruit has good color, fine texture, normal form, freedom from blemishes, and is heavy and juicy. This grade is commonly called "fancy." The next lower grade, which departs slightly from the characteristics of a "fancy" lemon, is called "choice." A still lower grade is called "standard," representing fruit that may be quite badly scarred or discolored, coarse in texture, or irregular in form, but merchantable. Frosted lemons are frequently shipped under this grade. A fourth grade, called "culls," is sometimes sold in near-by markets. Occasionally a shipper makes an "extra fancy" or an "extra choice" grade, terms which are self-explanatory, but which often do not represent fruit that is different from the ordinary "fancy" or "choice" grades.

Lemons are sized by hand, the extreme range of sizes in each grade varying from 180 to 540 to the box. There are few lemons shipped larger than the 240 per box size or smaller than the 490 per box size. The most desirable sizes are those which run 300 and 360 to the box.

Under normal conditions the markets of the South, including Kansas City, Mo., St. Louis, Mo., and Cincinnati, Ohio, prefer lemons which run 300 to the box with a few boxes of smaller sizes in each car. The markets north of this territory prefer the 300 size, with a few boxes of the larger sizes in each car, but do not like the smaller sizes. When lemons are scarce the sizes are of less importance. When the lemon is sold to a dealer in carload quantity at a fixed price per box, the sizes which run below 300 per box or above 360 are usually discounted from 25 cents to $1 a box, according to the sizes and the conditions of the market.

In the associations in which a number of growers join together and market their fruit cooperatively, the lemons are handled in a central packing house, usually located alongside the railroad. These packing houses are generally owned by the associations. The fruit of the different grades of all of the growers is commonly pooled and shipped, under the brand established for each grade, in the name of the association or of the exchange, which may act as a marketing agency for several associations, the grower receiving his pro rata share of the proceeds based on the weight of fruit in each grade into which his fruit is sorted at the time of packing. The shipping season is divided into periods called "pools," a month representing a common length of time for a pool.

THE KEEPING QUALITY OF THE LEMON.

The keeping quality of the domestic lemon is a subject not well understood. The keeping quality of the fruit, so far as the losses from decay are concerned, has greatly improved in the last few years, since the grower and handler have learned the relation that exists between the careful handling of the fruit and its ultimate preservation and since the nature of a destructive type of decay, the brown rot, which attacks the fruit principally during the curing period and sometimes while in transit, has been successfully worked out by Prof. Ralph E. Smith and his associates of the University of California.[a] An equally important phase of the subject that is not thoroughly understood and which affects the value of the fruit after it reaches the market as well as its storage quality in California is the relation that exists between cultural conditions, the methods of curing the fruit, the rapidity and length of time of curing, the degree of maturity at which it is picked and shipped, and other factors connected with its handling and shipping and the physiological processes affecting the ultimate life of the fruit. This phase of the subject is under investigation at the present time by Dr. R. H. True, of the Bureau of Plant Industry.

[a] Smith, Ralph E., et al. The Brown Rot of the Lemon. Bulletin 190, College of Agriculture, Agricultural Experiment Station, University of California.

A common form of loss in the lemon while in transit and in the markets is due to a blue-mold fungus, which gains entrance to the fruit through abrasions in the skin, usually produced by rough handling. This rot is still troublesome in fruit from sections in which the industry is not well organized and where the methods of handling the fruit are crude and rough. It is the result of poor business methods or lack of knowledge on the part of the growers, the packers, and the shippers. A convincing proof that the losses from blue mold can be avoided is to be found in the results secured by some of the largest commercial growers who handle the fruit with extreme care and who ship it under ventilation to the more distant parts of the country throughout the season without loss.

THE LEMON GROVE.

CULTURE.

The lemon groves in California are variable in size. The smaller ones contain from 5 to 10 acres. There are many of 20 to 30 acres, and a few owned by corporations that contain from 100 to 750 acres. The trees are planted from 20 to 25 feet apart each way, depending on the character of the variety. The groves are often double planted and the extra trees are cut out or transplanted when they begin to crowd. The principal varieties are the Eureka, the Lisbon, and the Villafranca. The soils on which the groves are planted and the locations are as variable as the sizes of the plantations. The growers usually prefer a uniform, deep, loamy, well-drained, high piece of land where the fruit is least likely to suffer from frost and is protected from high winds and where the soil is free from hardpan and is readily managed. All of the groves are irrigated once a month, or sometimes less often, from April or May to October, or until the winter rains begin, the frequency of irrigation depending on the character and condition of the soil and the effectiveness of the cultural methods in conserving moisture.

The tillage is intensive from spring till late summer, when a cover crop of vetch, bur clover, fenugreek, or Canada peas is drilled in or sown between the trees to supply the soil with nitrogen and with humus, in which the semiarid lands are especially deficient, for improving the texture of the soil, and for protection against washing by the heavy winter rains. The cover crop should be sown or drilled in early in the fall after the last irrigation. The land is then furrowed out so that the orchard and cover crop may be irrigated if the rainfall is short during the fall and early winter months. The cover crop should generally be plowed under by the 1st of March. The use of a cover crop in the lemon grove has become more general within the last few years, especially since it was found by Smith[a] that the

[a] Smith, Ralph E., et al. The Brown Rot of the Lemon. Bulletin 190, College of Agriculture, Agricultural Experiment Station, University of California.

brown rot of the fruit is more common in groves in which the land is bare during the winter.

FERTILIZING.

There is very wide variation in the quantity and character of the fertilizers applied to lemon groves. The best groves receive heavy applications of chemical fertilizer annually. It is not possible to discuss the fertilizing of the groves in detail, but a rough estimate of the amount of fertilizer annually applied per tree by the leading growers would be about 1 pound for each year the tree has been planted. Under this system a 5-year-old tree would receive 5 pounds and a 10-year-old tree 10 pounds of fertilizer. The average grove is not fertilized as heavily as this. Some of the most progressive growers fertilize their trees according to their individual needs rather than by the application of uniform amounts to all trees. Two applications of the fertilizer are generally made—one in the fall and another in the spring. When the trees are young and it is desired to force them and rapidly build up a strong framework, the fertilizer contains considerable nitrogen, though this form of plant food is derived mainly from the leguminous cover crops. As the trees grow older the proportions of potash and of phosphoric acid in the fertilizer are increased. Considerable stable manure is used, it being applied in the fall, so that it will be decayed before the tillage begins in the spring. The diversity in practice in fertilizing the groves in California shows that this phase of the culture of citrus fruits has not yet been satisfactorily worked out, though the same condition applies to the present knowledge of the requirements of other orchard fruits as well.

PRUNING.

The lemon tree is a vigorous and constant grower. When allowed to grow naturally it develops a number of upright shoots and slower growing laterals and may reach a height of 25 to 35 feet. With a tree of such large proportions the operations of picking the fruit and of fumigating or spraying the trees would be difficult and expensive. Lemon trees are therefore pruned once or twice each year, the aim being to keep the tree in a low, semi-upright, semi-open form, to make the main branches stocky and strong in order to carry the weight of fruit without breaking or swaying violently in the wind, and to stimulate the growth of fruit-bearing wood all over the tree, especially on the inner branches, which produce the lemons of finest form and texture. A Lisbon lemon tree 9 years old that has been pruned annually is shown in Plate XXXIX, figure 1.

The trees are seldom entirely dormant, but grow with greater vigor at several periods from spring till fall, and slowly during the winter months. Occasionally an attempt is made to make the trees bear more heavily in the spring and summer by frequent or unusual prun-

FIG. 1.—A LISBON LEMON TREE, NINE YEARS OLD, CALIFORNIA.

FIG. 2.—AN ORANGE GROVE EQUIPPED WITH SHEET-IRON STOVES READY FOR FIRING TO PROTECT THE TREES FROM FROST, CALIFORNIA.

ing or irrigation, but the results have been of doubtful benefit. The Eureka is being planted more than other varieties, as it matures a larger proportion of fruit in the spring and summer.

There are a number of systems of pruning and training the lemon tree in use in California. In a general way they consist in shortening the wood, removing the strong-growing suckers, and thinning out the top when it becomes too dense.

In a young tree the main branches, four or five in number, are started about 2 feet from the ground and should not be opposite each other. In general, the pruning for the first three or four years consists in cutting out or shortening to lateral buds the central upright leaders, in order to give the tree an open, laterally upward form. The strong main laterals are also headed in to make them stocky, but the finer fruit-bearing wood is not pruned. The lower branches of the tree are frequently cut back or removed, but should be allowed to develop untouched, as the first fruit that the tree produces is borne on them. These branches should be removed as the tree grows older and the top becomes more dense. Some of the growers do not prune the trees until they have been planted two or three years, when they begin to form the top somewhat after the manner described.

As the trees grow older and the weight of fruit causes the branches to droop, the lateral growth is not often cut back, but the pruning consists in the removal of the sucker wood, in cutting back to 6 to 8 inches, and in thinning out the growth that develops over the top of the tree as a result of the former prunings, especially in a strong-growing variety like the Lisbon. The aim of the pruning is to increase the fruit-bearing area each year and to keep the tree sufficiently open to induce an interior growth of fruit-bearing wood from the strong branches, as the lemons of most perfect form and of thinnest texture are produced in the shaded portions of the tree. The fruit that is exposed to the sun is coarse and is inclined to be flat sided. The lower branches are often kept pruned away from the ground in order to reduce the attacks of the brown rot, which is caused by a fungus growing in the soil.

PROTECTION AGAINST FROST.

There are few districts in the citrus belt of California that may not be visited by frost in December, January, or February. The prevention of injury by frost may be influenced to a large extent by the location of groves on lands over which there is a sufficient air drainage. The new groves established during the past few years have been located on the higher lands with this factor prominently in view. To protect them against the extreme cold, many of the groves on the lower lands are equipped with wicker coal baskets, briquets of shavings, crude oil, and asphaltum, or sheet-iron stoves in which the same material is burned. Oil smudges (in tin recep-

tacles) or other materials which are located at definite intervals in the spaces between the trees are sometimes burned. It is a common practice, also, to run the water in the irrigating furrows between the trees on cold nights, in order to make use of the latent heat in the water as a means of frost protection. The materials employed in the protection against frost injury are used to cause a circulation of air over the grove in order to mix together the strata of different temperatures or for the production of a cloud of smoke over the grove in the morning in order to exclude the direct sunlight and thereby prevent the rapid thawing of the fruit when it has been frozen during the preceding night. It is the rapid thawing, rather than the freezing of the tissues, that causes most of the injury to citrus fruits that have been subjected to ordinary frost temperatures.

A general idea of the operation of frost fighting may be gained from a brief description of the work observed in a grove on a cold night. There were 25 perforated sheet-iron stoves scattered over each acre of grove, one stove being placed in the center of the square between four trees. These stoves were filled with a prepared mixture of shavings, asphaltum, and crude oil. When it was determined to light the fires a force of men appeared, each one carrying a can of oil and a torch. A small quantity of oil was poured over the smudging material and was then quickly lighted with the torch. As soon as all the fires were burning, the men returned home, except one man to about 5 acres, who kept the fires replenished and in good burning condition. An orange grove equipped with sheet-iron stoves is shown in Plate XXXIX, figure 2. A lemon grove with briquets in place ready for firing is shown in Plate XL, figure 1.

Just how much benefit is derived from these various devices it is difficult to estimate, as the experience of the growers is conflicting and the experiments that have been conducted have not always been comprehensive. There seems to be no doubt, however, that the judicious use of the various devices used in frost protection has been of great commercial value. One who has had an experience of many years and who has large financial interests involved writes:

> We have been able to protect against the severest cold we have had since we secured the coal baskets. Several times the temperature has been around 24° or 25° until we got our coal baskets under way, but we were usually able to make a change of from 3° to 5° when our baskets were lighted and were giving off a good heat.

Aside from the injury to the fruit and the young wood by frost, continued cold weather causes the wood of the lemon trees to mature and the fruit to develop a coarse, rough texture and to ripen prematurely.

INSECT AND FUNGOUS TROUBLES.

The lemon grower in most sections has to be constantly on the alert to protect the groves against insect pests, the most common of

FIG. 1.—A LEMON GROVE, SHOWING BRIQUETS READY FOR FIRING TO PROTECT THE TREES FROM FROST, CALIFORNIA.

FIG. 2.—A LEMON GROVE, SHOWING PICKERS WITH PICKING SACKS, CALIFORNIA.

which are the red, purple, and black scales, and in local areas the silver or rust mite. If the scale insects are not controlled by fumigation or by spraying and the mite by sulphuring, an infested grove may become commercially unprofitable and the life of the trees endangered after a few years. Fortunately, the scale insects can be controlled by fumigating the trees with the fumes of hydrocyanic acid gas every two or three years or by treating the trees with a distillate oil spray. The former treatment has almost replaced the latter. The fumigation is done in the fall or winter, at night or during cloudy weather in order to avoid the burning of the foliage, which frequently occurs when the trees are fumigated in the sunlight. The fumigation is done by the growers or more often by contractors, who make a business of fumigating groves, or by a force employed by an association of which the grower is a member. It costs from 25 cents to $1.50 a tree, according to size, to fumigate trees. A special investigation of the use of hydrocyanic acid gas in the fumigation of citrus fruit groves is now being made by the Bureau of Entomology of this Department.

The grower has to be equally watchful to protect the trees and the fruit against fungous diseases and other types of disorders. One of the most common and destructive troubles is the gum disease, apparently a physiological disorder that attacks the tree generally on the body near the ground when it is set in wet soil or under other unfavorable conditions. This trouble most often affects the trees at the lower end of the irrigation rows, where the sediment from the soil above is gradually accumulated around the tree. The nature of the gum disease is under investigation by Prof. R. E. Smith, pathologist of the University of California. There are also a number of minor troubles that cause the dying back of the small branches and the mottling or chlorosis of the leaves.

The most destructive disease that attacks the fruit is the brown rot, *Pythiacystis citrophthora*, Smith.[a] This is a virulent form of rot that has caused large commercial losses in the fruit, principally in the packing house, but which may attack the fruit on the tree or while in transit from California. The brown rot is primarily a soil fungus, which grows most freely in moist locations. The spores formed in the soil may reach the fruit on the lower branches and start decay while it is growing on the tree, or the spores may be carried with the fruit into the water of the washing machine, where the sound lemons passing through the machine become infected. These infected lemons develop the disease in the curing tents and in turn communicate it by contact to adjoining lemons until an entire box of fruit is lost in this way. Smith has found that the disease is lessened by keeping the surface of the soil under the trees thoroughly

[a] **Smith, Ralph E., et al. The Brown Rot of the Lemon. Bulletin 190, College of Agriculture, Agricultural Experiment Station, University of California.**

stirred during the season of tillage, by pruning the lower branches so that they do not lie on the ground, and by covering the ground around and under the trees during the fall and winter with a cover crop. He has found also that the disease may be still further controlled by the elimination of decaying fruit when it comes from the washing machine, by disinfecting the water of the washing machine with formalin, copper sulphate, or permanganate of potash, and by the frequent separation of the infected lemons from the sound fruit while curing or in storage.

THE COST OF MAINTAINING A LEMON GROVE.

A lemon grove is an expensive property to develop and to maintain in a highly productive condition. There is a wide difference in the amount of money expended in the maintenance of various groves in California, and a corresponding variation in the net returns. It is probably fair to estimate that the annual cost of producing the crop to the time of harvesting varies from $75 to $150 per acre on groves of bearing age. A general idea of the cost of handling a grove, as well as the crop of fruit, may be gained from the following concrete example, showing the amount expended by one of the best growers in the State in an average year on a 20-acre grove of bearing age. The amount of money expended on this grove, as well as the yield of fruit, is considerably above the average of the best groves in the State. The yield per acre on this grove was 349½ boxes, or 37½ boxes more than a carload of fruit. This yield exceeds the average of the better groves in California and is far above the yields of groves receiving ordinary care. A fair estimate of the average yield of groves 10 years of age or older receiving the best of care is probably about 25,000 pounds of fruit for shipment, equivalent to a carload, while the yield of the groves receiving ordinary care would not exceed 12,000 to 13,000 pounds for shipment, or the equivalent of about one-half a carload to the acre.

Annual cost of maintaining a bearing lemon grove of 20 acres.

	Total cost.	Cost per acre.
Cultivation	$322.18	$16.10
Spraying	49.83	2.49
Pruning	169.83	8.49
Fertilizing	165.75	8.29
Irrigation	128.28	6.41
Water tax	171.76	8.59
Picking	1,915.90	95.80
Packing-house expense, including curing, packages, packing, loading, etc., 6,989 boxes at 54 cents per box	3,774.06	188.70
Expenses, such as manager's salary and office charges, not included in above items	719.88	35.99
Total	7,417.47	370.86

The average return per car f. o. b. in California during the last few years varies widely, but a rough estimate of the returns is as follows: 1903–4, probably somewhere near $400; 1904–5, between $600 and $675; 1905–6, between $800 and $900; 1906–7, between $850 and $950. The fruit from some of the best groves has averaged considerably higher than the maximum figures given above. In some of the better localities the growers have averaged about 3 cents a pound for the fruit on the trees during the last two or three years, the fruit in the poorer districts averaging from 2 to $2\frac{1}{2}$ cents a pound on the tree.

In considering these general figures, the reader should bear in mind that they are rather above the average that might be expected over a long term of years, as the price of horticultural produce of all kinds has been unusually high during the last few years of general prosperity.

HANDLING THE LEMON CROP.

PICKING.

The lemon is picked, irrespective of the degree of maturity of the fruit, when it reaches the approximate size desired by the market. If it is allowed to ripen on the tree the fruit is likely to be overgrown, coarse in texture, lacking in acidity, and of poor keeping quality. In order to judge accurately, each picker is provided with a ring to be used in testing the size of the lemons. If the fruit is to be held several weeks or months before shipment, the ring generally has a diameter of $2\frac{5}{16}$ inches, which allows for considerable shrinkage while the fruit is in the storage house. If the lemons are to be shipped soon after picking, the ring usually has a diameter of $2\frac{1}{4}$ inches. With size rather than maturity as the leading factor in determining when the fruit shall be picked, the lemons vary in color from dark green to yellow, and in texture from the thin skin of the tree-ripened lemons to the coarse green lemons that grow on the outside branches. It is necessary to pick a vigorous-growing grove once a month, on the average, in order to avoid having a large proportion of oversized lemons. In picking the fruit the picker cuts from the tree with shears or clippers the lemons that do not pass through the ring. He also picks the smaller lemons that have ripened on the tree and have reached full growth. The fruit is placed in picking sacks slung over the shoulder of the picker, as shown in Plate XL, figure 2, and is hauled in boxes to the packing house. The handling of the fruit in the grove is done with extreme care to avoid cutting it with the clippers, stem puncturing it, or bruising it in other ways.

HANDLING IN THE PACKING HOUSE.

The handling of the fruit after it reaches the packing house is a series of complex operations requiring skill and experience. The

fruit has to be cleaned, graded, and colored or ripened uniformly before it is ready for shipment. In addition, it may be desirable to hold it in storage for several weeks or months for better market conditions. A lemon storage house is shown in Plate XLI, figure 1.

WASHING.—The fruit is first washed by running it between brushes submerged in a tank of water or with water running on to the brushes, to remove the dust or the sooty-mold fungus that follows the black scale. The washing makes the lemons bright and clean. During the season of brown-rot infection, from January to July, the water in the washing tank is usually disinfected with a solution of permanganate of potash or of copper sulphate. A common type of washing machine and a canvas sorting table are shown in Plate XLI, figure 2. When the fruit emerges from the washing machine it passes over a canvas table or a moving-belt table, where it is sorted into three colors, representing different degrees of maturity—the dark green, or unripe; the silver green, or partially mature; and the yellow, or tree-ripened lemons. The different lots are placed in separate boxes or trays in an undried condition, and the dark-green and silver-green lemons are placed in storage separately to color and mature. The tree-ripened yellow lemons are generally shipped at once on account of their comparatively poor keeping quality.

COLORING THE FRUIT.—If there is a strong demand for fruit from December to March and the weather is cool, the dark-green and silver-green lemons are placed in tight rooms, called "sweat rooms," of a carload capacity each or in tents, and the fruit is colored quickly by raising the temperature to between 90° and 95° F. with wickless kerosene stoves. A pail of water is placed on each burner of the stove to moisten the air to prevent the shriveling of the fruit. Under this treatment a silver-green lemon colors in about four days and a dark-green lemon in six days. If the fruit remains in the sweat room too long the changes go too far, the fruit loses its natural luster, and the keeping quality is supposed to be injured.

CURING AND STORING.—The lemons that are not intended to be shipped for several weeks or months are placed in an unpacked condition in boxes or trays in the storage houses, either in canvas tents of a carload capacity arranged in rather open buildings or sheds, as shown in Plate XLII, figure 1, or piled in boxes or trays in cellars in which the ventilation is under control. Under these conditions the fruit colors slowly, the moisture evaporates from the skin, and the tissues of the skin shrink, giving it a velvety, tough texture and a bright waxy appearance. The aim is to regulate the temperature and humidity of the tents or cellars, so as to prevent the shriveling of the skin or the saturation of the air with moisture. In the house shown in Plate XLI, figure 1, the lemons are stored without tents in the

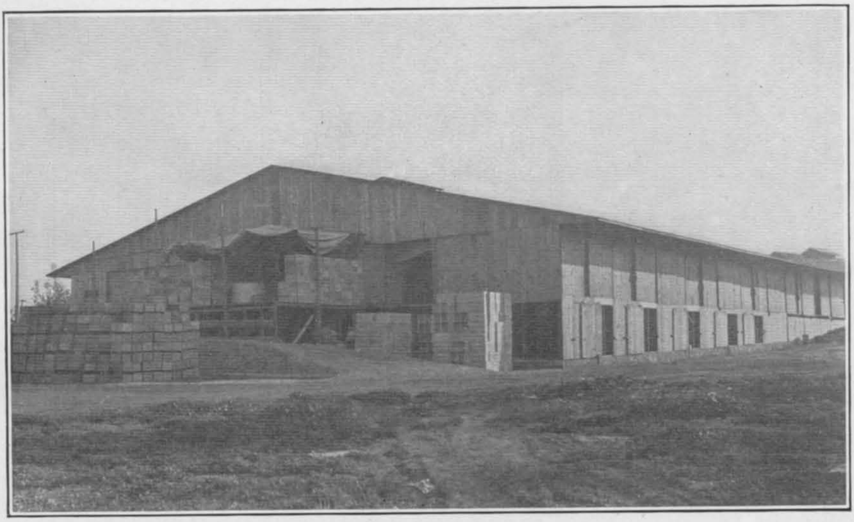

FIG. 1.—A LEMON STORAGE HOUSE, CALIFORNIA.

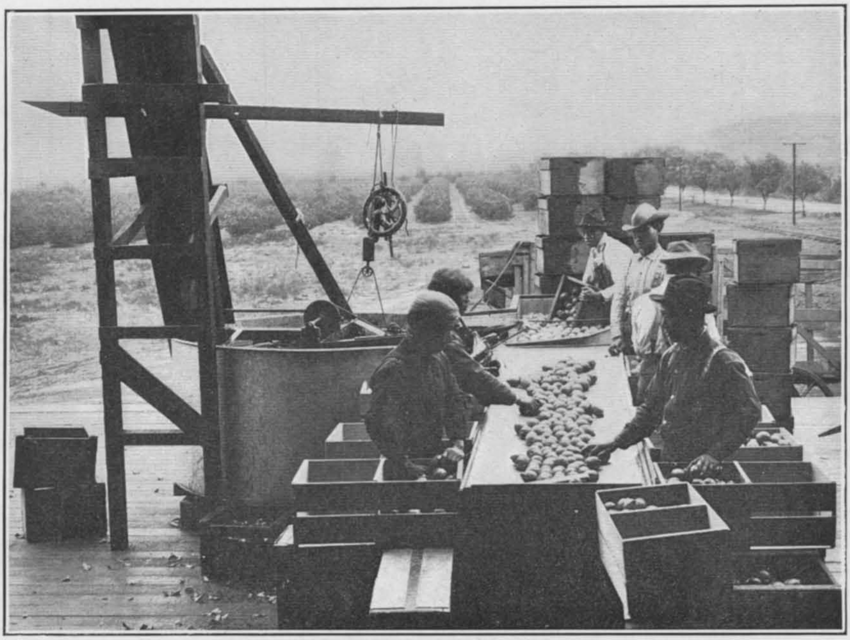

FIG. 2.—A LEMON WASHING MACHINE AND A CANVAS SORTING TABLE, CALIFORNIA.

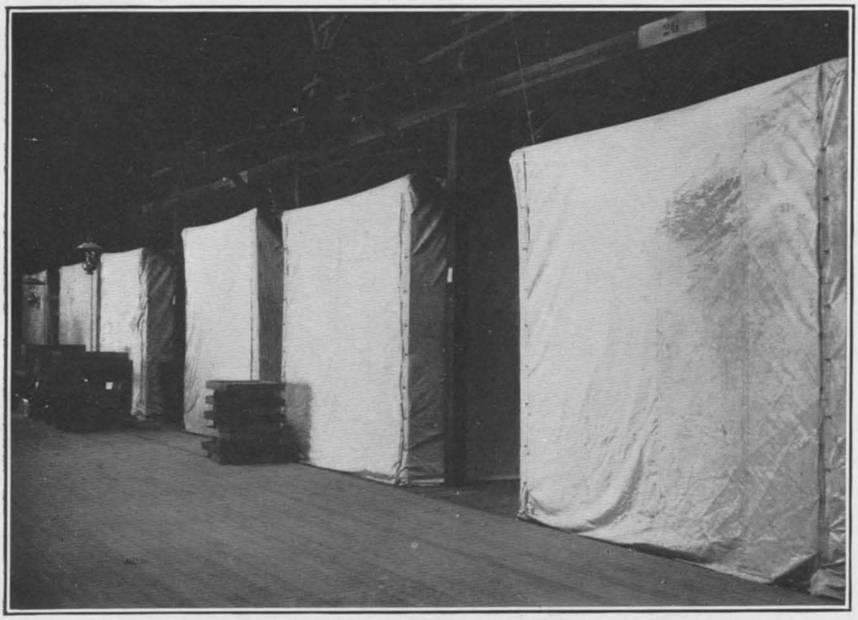

FIG. 1.—INTERIOR OF STORAGE HOUSE EMPLOYING THE TENT SYSTEM OF LEMON CURING, CALIFORNIA.

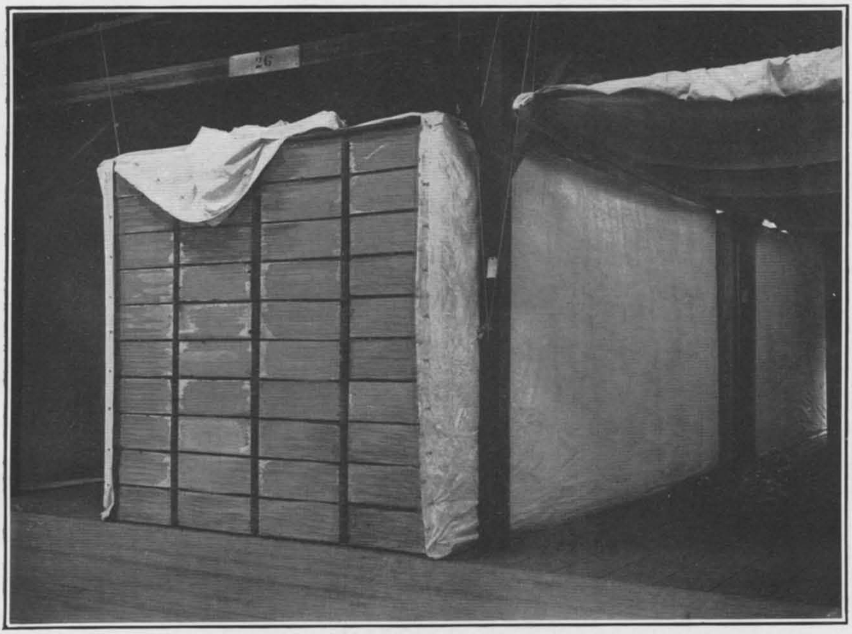

FIG. 2.—A LEMON TENT, SHOWING MANNER OF STACKING BOXES, CALIFORNIA.

CALIFORNIA LEMONS.

A, FRESH PICKED FRUIT. B. CURED FRUIT.

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ventilated basement, and under the tent system on the upper floor. When the fruit is handled properly, a green lemon picked in December may be kept in the tents or cellars in good condition four or five months, January lemons about four months, and green lemons picked in February, March, and April from two to three months. Fresh picked and cured California lemons are illustrated in Plate XLIII.

In the curing of lemons, the fruit is protected from the extreme changes in temperature and humidity of the outside air by the structure of the lemon curing house and by the use of the tents, which may be raised or lowered in accordance with the outside conditions. A tent with the canvas raised in front, showing the piling of the boxes, is shown in Plate XLII, figure 2. It appears to be desirable to keep the fruit in the most uniform condition of temperature and humidity possible. In the interior districts, where the changes in temperature and in humidity are more marked than in the coast region, the desired uniformity is maintained by the use of insulated walls and roofs, by the storage of the fruit in basement cellars, and by the further regulation of the interior of the house by ventilation. In addition to this, the equalization of the temperature and humidity may be carried further by the use of tents over the individual stacks of fruit. In the coast region, where the climatic conditions are less variable, the temperature and moisture of the air surrounding the fruit are equalized sufficiently by simply inclosing the fruit in the tents, which are arranged in rather open sheds. These tents are opened at night when desirable to cool the fruit, or they are kept open whenever it is unusually damp and a circulation of air is desired throughout the fruit. The tents are closed whenever the air is unusually dry in order to keep the fruit from shriveling.

TEMPERATURE AND HUMIDITY.

The effect of packing-house structure in modifying the extremes in temperature and humidity is shown in the accompanying diagrams,

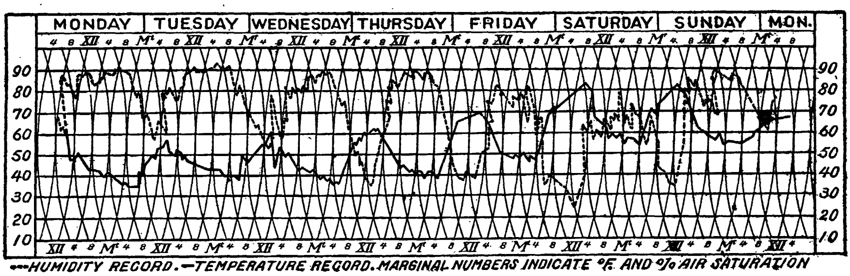

FIG. 35.—A record of the humidity and the temperature out of doors for one week, California.

figures 35 and 36, prepared from records obtained by Dr. R. H. True, of the Bureau of Plant Industry, in the course of a series of investi-

gations on lemon curing in 1907 at Riverside. This region is characterized by rather rapid and extreme changes, as shown in figure 35, which is a record for the week ending April 1, 1907. In figure 36 are

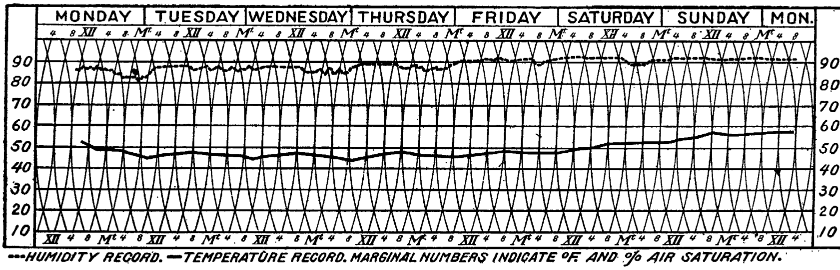

FIG. 36.—A record of the humidity and the temperature in a lemon storage house for one week, California.

shown the humidity and temperature for the corresponding period, taken in a stack of lemons undergoing curing in a neighboring insulated packing house.

CARE IN HANDLING.

The handling of the lemon in the packing house is done with more care than is bestowed on any other orchard-fruit crop. The shippers have found from costly experience that the dropping of the fruit or the rough handling of it in any other way is followed by heavy losses from decay. The injunction to " handle the fruit like eggs " is kept constantly before the laborers, and this care in handling is consistently practiced in the well-managed packing houses.

ESSENTIALS IN CURING.

The regulation of the temperature and humidity in the curing houses, so as to prevent the shriveling of the fruit; the saturation of the air, and the handling of the lemons affected with the brown rot are operations requiring the finest judgment and skill on the part of the managers of the packing houses. At the present time most of these matters are regulated by judgment, but it is not too much to expect that the management of the fruit in curing and storing will soon be reduced to exact scientific methods as the requirements of humidity, temperature, and ventilation, as well as other questions, are gradually worked out.

FOOD AND DIET IN THE UNITED STATES.

By C. F. Langworthy, Ph. D.,
Of the Office of Experiment Stations.

INTRODUCTION.

The food of any individual or family is to a very large extent determined by circumstances. Anthropologists claim, and with good reason, that in the earliest days of the human race man lived without much choice on the food which he could obtain, being fitted by his inheritance from earlier forms of life to use a large variety of foodstuffs. If he happened to be an inhabitant of sea coast regions, shellfish and other sea food, which could be readily procured, were eaten in quantity. If he lived in inland regions where nuts, wild roots, and seed-bearing grasses were abundant, such foods were used, and no one can doubt that game birds and their eggs and such other animal foods as were available were eaten.

In general, the food habits of the human race to-day are an expression of the thousands of years of experience in which man has sought to bring himself into harmony with his environment, and food habits have been determined, as regards materials selected, by available supply, man being by nature omnivorous.

POPULAR IDEAS REGARDING DIET.

The majority of persons get their ideas of the food habits of a race or region from popular writings, and often the source of information is inaccurate or incomplete. If a writer states that the diet in New England is pork and beans and brown bread, or that in the South it is corn meal and pork, we all know that the statement is very inadequate. But when such statements are made about the diet in less familiar regions the error is not so obvious.

It is often said and is generally believed that we have a generous diet in the United States and that the range in variety of food products is unusually large. Our dietary results from many customs and food habits of the races which have helped to make up our population, but in its general character it is British, as is natural, for the bulk of the earliest settlers were from Great Britain and brought the customs and manners of the old home with them, adapted them to the new country, and passed them on to the succeeding

generations. As time has passed there have been marked changes in the character of the diet, owing to improved methods of cultivation of food crops, to better methods of transportation and storage, to improvement in house construction and kitchen appliances, and to similar factors. Whether the value of the daily diet has changed when considered from the standpoint of nutritive material supplied is another matter, and one which it is more difficult to decide.

It is not without interest to consider in more detail some of the factors which have modified dietary habits. In northern regions of the United States, in earlier times, the vegetable supply in the summer was fairly abundant, but in the winter was limited to a few varieties, chiefly root crops, which were of good keeping quality. Eggs, salt meats, and less commonly poultry were staple summer foods, but fresh beef, mutton, and pork were much more abundant in winter, when they could be kept frozen in good condition, than in summer. The lack of variety of vegetable foods in winter and of fresh meat in summer was without doubt the reason for the great variety of preserves and pickles which every housewife deemed necessary, and for the great number of kinds of pastry, cake, and similar dishes. In other words, there was a craving for variety, and it was satisfied by using in many different ways the comparatively small number of food materials which were most commonly obtainable.

As regards different regions, we find that the available food supply very largely determines the food habits for the family or group, as it was stated earlier that it does for the race. Thus we find that in rural regions in the Southern States beef and mutton, which must be kept with ice after slaughtering, are less common food than poultry, which may be easily raised and kept alive until needed. In the same way, corn meal and other corn products, which are readily available, have always been popular foods, as have cowpeas, gumbo and collards, sweet potatoes, and the large variety of other southern vegetables which are so palatable.

In the case of Germany, England, and other European countries the information which is available regarding foods and food habits is large in amount, and the popular statements which are made concerning them are accurate in the main. It is by no means unusual, however, to find misstatements which only too often pass without question. For instance, the writers who describe the potato diet in parts of rural Ireland not infrequently omit to mention the skim milk or the bacon which goes with it. The peasants in many regions of the Continent "taste meat hardly once a year," we are often told. A study of their diet usually shows that cheese, milk, and other foods are used to replace the meat they find too expensive, and the diet is not actually so limited as at first sight it would seem to be. Mention is much less commonly made in popular writings of the great number

of the wage-earners of these countries who have a generous and varied diet, as is evident from a study of the available data on the subject.

Erroneous statements regarding food and diet in different eastern countries are very frequently met with, though in many cases the question has been so often studied that reliable information is readily accessible. For instance, it is commonly said that Chinese, Japanese, and other oriental races live upon rice, and that large amounts of severe physical work are performed on a few handfuls of this cereal per day. Careful study of oriental dietetics shows that although rice is undoubtedly one of the most important foodstuffs, it fills much the same place in the diet that wheat and other common starchy foods do in the diet of western races. In other words, it is the most common and abundant starchy food. Food customs vary in the different oriental countries, but on the whole it may be said that eggs, fish, poultry, meat, and legumes are well-known nitrogenous foods and that the diet as a whole is usually adequate, particularly when considered in relation to body weight.

It is generally true that the more we learn about diet in remote regions, and the more accurate our knowledge regarding kinds and amounts of food eaten, the fewer the anomalies and the closer the resemblance in nutritive value to more familiar conditions.

DIETARY STUDIES AND THEIR OBJECT.

If really reliable information regarding the food of a family or a race is wanted, it must be secured by means of carefully conducted studies of the kind and amount of food eaten, the results being so expressed that they may be readily compared with other similar data.

With the growth of the scientific spirit and method and its application to all branches of learning, it is not surprising to find that the attempt should be made to carefully record and express in chemical terms the food habits of man in different countries, the underlying idea being that such a summary of data should show the practice of those who are in health, comfort, and vigor, whose lives are long and whose offspring are healthy, and that this would be valuable as a guide for others. Such an inference seems natural and reasonable, for it is difficult for those who believe that the human race has developed and improved as it has lived to conclude otherwise than that the customs of a race represent the accumulated wisdom of the ages of experiment and experience which have gone before.

European investigators began about 1850 to collect such information regarding dietetics and to reduce it to chemical terms, and the average values which they found, often interpreted in the light of laboratory work, were commonly called dietary standards. Such compilations were new in form rather than in practice, for earlier

students and thinkers had collected similar data and made deductions therefrom, though the results were expressed in different terms.

American investigators followed the lead of European scientists, Prof. W. O. Atwater, who was so long in charge of the nutrition investigations of this Department, being a pioneer in the work, and a great deal of information was accumulated regarding the foods eaten by individuals and groups living under different circumstances.

METHODS OF RECORDING DIETARIES.

Foods are used in the body in two ways, namely, to build and repair body tissue and to furnish the body with the energy required for maintaining vital processes and for muscular work. The body cells, which make up all the organs and tissues, contain nitrogenous material as an essential; hence foods containing this element are an indispensable part of the diet. Nitrogenous foods, such, for instance, as lean meat, egg white, the wheat gluten, etc., contribute also to the energy value of the diet, but the body depends for its energy very largely upon fats and carbohydrates, a given quantity of fat, for instance that of butter, yielding two and one-fourth times as much energy as a like amount of carbohydrates, such as sugar, starch, etc.

In the methods usually followed in expressing the results of dietary studies the functions of food, as expressed above, are had in mind, and the results attempt to show the value of the daily ration as a tissue former and an energy yielder.

The results of dietary studies and the dietary standards deduced from them have been very commonly expressed in terms of protein, fat, and carbohydrates. It is, however, simpler to express the results in terms of protein and energy only, and this is now more usually done, as these factors give data regarding both functions of the diet and constitute the simplest basis on which different foods, rations, standards, etc., can be compared. Various attempts have beeen made to express the value of different foods and different diets by a single term, but this is not possible, since the two functions which food serves can not be expressed in any common unit. The dietary standard expressed in terms of protein and energy only does not, of course, take account of the proportion of fats and carbohydrates present, and from the theoretical standpoint it is not necessary to do so as it is immaterial which of these two classes of nutrients supplies the energy. From a practical standpoint, however, the proportion is of the greatest importance on account of its relation to the wholesomeness and palatability of the diet. The proportions which are usually consumed in the American diet are not far from 150 grams fat, and 350 grams carbohydrates, per 100 grams[a] protein.

[a] 100 grams equal 0.22 pound.

PROPORTIONS EATEN BY MEN AND WOMEN OF DIFFERENT AGES.

It is convenient to record the results of dietary studies in like terms as regards the age and sex of the persons included, and the amount per man per day seems the most satisfactory basis of comparison.

Everyone knows that the young child takes less food than the older, and that there are variations through adolescence to the periods of full vigor and old age. The numerous food investigations which have been carried on have furnished data for estimating the amounts consumed by children of different ages and by men and women at different periods of life, and general factors have been deduced which are shown in the table below, and which are used in calculating the results of dietary studies to the uniform basis "per man per day."

A man in full vigor at moderate work has been selected as the unit for comparison and assigned the value of 100. The greater or smaller requirements of men at more severe work and of women and children are shown by values greater or less than 100 as the case may be.

Relative values for food requirements of persons of different age and occupation as compared with a man in full vigor at moderate work.

Man, period of full vigor:		Boy:	
At moderate work	100	15 to 16 years old	90
At hard work	120	13 to 14 years old	80
Sedentary occupation	80	12 years old	70
Woman, period of full vigor:		10 to 11 years old	60
At moderate work	80	Girl:	
At hard work	100	15 to 16 years old	80
Sedentary occupation	70	13 to 14 years old	70
Man or woman:		10 to 12 years old	60
Old age	90	Child:	
Extreme old age	70–80	6 to 9 years old	50
		2 to 5 years old	40
		Child under 2 years old	30

It is evident from the figures quoted that there is an increase in food consumption from infancy until full vigor and that the food requirements again diminish in old age. The figures also show that during youth and old age sex does not have a marked effect on food requirements, but from the time growth is complete until old age a woman requires less food than a man engaged in the same kind of work. This difference, which is based on observation of the amounts eaten under average conditions, is explained by the fact that woman's stature is on an average less than man's, and the amount of work done is less, the food requirements being proportional to the size of the body and the quantity of work it performs.

Data regarding the food requirements in old age are especially interesting, as comparatively little information was available on this subject until dietary studies were recently undertaken in old age homes in Baltimore and Philadelphia as a part of the nutrition

investigations of this Department. The results obtained clearly show that smaller amounts are eaten when the period of full vigor has passed and that in extreme old age, when most of the day is spent in quiet and rest, the quantity of food desired is comparatively small.

SUMMARY OF RESULTS OF DIETARY STUDIES.

Though many American investigators have contributed to the study of the food of man, by far the larger part of such work in this country has been carried on in connection with the nutrition investigations of the Department of Agriculture, and over 500 studies have been made to learn the kinds and amounts of food consumed by individuals and groups and what it represented from a chemical standpoint. In this work it has been the purpose to include as many regions and as great a variety in employment, materials, surroundings, and other conditions as possible. The attempt has also been made, except in studies undertaken for some specific purpose, to study normal individuals in good health and not abnormal or unusual types.

The table below summarizes the data thus collected, the results being expressed in terms of protein and energy; that is, in such a way that they show the proportion of tissue-building material supplied and the energy value of the diet. It is believed that the results are fairly representative of actual conditions.

In selecting dietary studies of Europeans and others, for purposes of comparison, general averages were not available and it was necessary to choose such studies as seemed similar in purpose and method to the American work, preference being given to those which were recent and carried on with reasonable accuracy and which, so far as could be judged, represented usual and normal rather than abnormal or experimental conditions.

Results of dietary studies in the United States and other countries.

Persons.	Total protein eaten.	Energy of total diet.	Digested protein.	Energy utilized.
United States:				
Men at hard muscular work:	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Artisans, laborers, etc., average of 24 studies	[a]177	[b]6,485	162	6,000
Athletes, average of 19 studies	198	4,980	182	4,510
Men at moderate muscular work: Farmers, artisans, laborers, etc., average of 162 studies	100	3,685	92	3,425
Men not employed at muscular occupations: Business men, students, etc., average of 51 studies	106	3,560	98	3,285
Men with little or no muscular work: Inmates of institutions, average of 49 studies	86	2,820	80	2,600
Very poor working people, average of 15 studies	69	2,275	64	2,100
Canada: Factory hands, average of 13 studies	108	3,735	99	3,480

[a] 100 grams equal 0.22 pound.
[b] The calorie is the unit used to measure heat. One calorie equals nearly 1.54 foot-tons.

Results of dietary studies in the United States and other countries—Continued.

Persons.	Total protein eaten.	Energy of total diet.	Digested protein.	Energy utilized.
	Grams.	*Calories.*	*Grams.*	*Calories.*
West Indies: Farmers, light work, Leeward Islands	82	----------	75	3,085
Ireland: Workingmen	98	----------	90	3,107
England: Workingmen	89	----------	82	2,685
Scotland:				
Workingmen	108	----------	99	3,228
Students	143	----------	132	3,979
Finland:				
Workingmen	114	----------	105	3,011
Workingmen (hard work)	167	----------	150	4,378
Students	157	----------	144	3,984
Sweden:				
Workingmen	134	----------	123	3,281
Workingmen (hard work)	189	----------	174	4,557
Students	127	----------	117	3,032
Russia:				
Factory hands	119	----------	109	3,194
Miners (hard work)	155	----------	143	4,000
Northern Italy: Laborers	125	----------	115	3,655
Southern Italy: Laborers	148	----------	136	4,400
Italy: Farmers and mechanics	125	----------	115	3,400
Germany:				
Workingmen (hard work)	134	----------	123	3,061
Farmers	137	----------	126	4,530
Professional men	111	----------	102	2,511
France:				
Men (light work)	110	----------	101	2,750
Farmers (south of France)	149	----------	137	4,570
Belgium:				
Workingmen	92	----------	84	3,000
Farmers	136	----------	125	4,370
Poland: Well-to-do families	121	----------	111	3,015
Japan:				
Laborers	118	----------	103	4,415
Laborers (hard work)	158	----------	137	5,050
Professional and business men	87	----------	75	2,190
Students	98	----------	88	2,800
Java: Men (light work)	73	----------	67	2,500
China, Lao-Kay: Laborers	91	----------	83	3,400
Anam: Laborers	134	----------	123	3,866
Egypt: Native laborers	112	----------	103	2,825
Congo: Native laborers	108	----------	99	2,812

In the above comparison the values for the United States represent the averages of a large number of studies. In the case of the dietaries selected for comparison it has been the object to take the mean rather than the extreme values. It will be seen that all things considered there is a comparatively wide range in both protein and energy. This is true whether we consider nutrients consumed or nutrients digested. If, however, the results are considered as a whole,

it becomes apparent that the majority of them do not differ very markedly from a general average of 100 grams protein and 3,000 calories of energy and that it is fair to say that although foods may differ very decidedly the nutritive value of the diet in different regions and under different circumstances is very much the same for a like amount of muscular work. In this connection it is interesting to quote the conclusion reached by Paton and Dunlop,[a] of Edinburgh, with respect to this question:

> The study of the ordinary diets of the laboring classes in all countries seems to show that whenever possible a diet is secured which will yield something over 3,000 calories of energy and over 100 grams of proteids per man per diem.

FACTORS WHICH AFFECT FOOD REQUIREMENTS.

The average requirements of a normal individual are affected by a number of factors, of which the most important are sex, age, size of the body, and the amount of muscular work performed. The last mentioned is by far the most important, at least as regards the energy value after the body has gained its normal size. Other factors which have an influence on food requirements are climate, the bearing and nourishment of children, the pathological conditions due to diseases of different sorts, and other abnormal conditions. Of these factors the influence of age and sex has been considered in a preceding section (p. 365). As regards climate and seasons, the general conclusion reached is that more energy is required in cold than in warm weather, and it has been estimated that in winter the energy requirement is greater by 800 calories than in summer. Acute and chronic diseases and other abnormal conditions have a very decided effect on protein and energy requirements, and a knowledge of such conditions with reference to the kind and amount of food needed must form the basis of rational invalid dietetics. one of the most important subjects in the practice of medicine.

Just as there are persons apparently normal in other respects who can not distinguish between certain colors, so there are those apparently in perfect health and vigor whose food requirements differ markedly from those of the average normal individual. Such exceptions are interesting, but need not be considered in general discussions of protein and energy requirements.

EFFECT OF SIZE ON FOOD REQUIREMENTS.

The average stature and weight of individuals of different races varies decidedly, a fact which is well known and which is easily proved by consulting military statistics regarding the height and

[a] Proc. Roy. Soc. Edinb., 25 (1904–5), p. 498.

weight of soldiers, and similar reliable data. Such facts, however, are often disregarded in discussing the results of dietary studies, though no one can doubt that it is more accurate to discuss dietary standards and similar questions on the basis of a unit of body weight or some similar factor than on the per man per day basis. If due allowance is made for variations in body weight, figures for amounts of nutrients and energy eaten per man per day, which at first sight seem very dissimilar, are after all found to resemble each other quite closely. For instance, the results of fourteen dietary studies with American professional and business men showed that they consumed a diet which supplied 104 grams protein and 3,220 calories of available energy, and with Japanese of similar employment, as shown by thirteen studies, 87 grams protein and 2,190 calories of energy. The Americans weighed on an average 150 pounds and the Japanese 105 pounds. If we compare the two sets of figures on the basis of a uniform weight of 150 pounds, the values for the Japanese become 105 grams protein and 3,120 calories of energy.

It is obvious that a uniform basis in making comparisons should not be overlooked in discussing many questions of food and diet.

MUSCULAR WORK IN RELATION TO FOOD EATEN AND REQUIRED.

Muscular exertion—that is, the amount of physical work performed—is one of the most important factors which determine the amount of food eaten. Everyone recognizes the fact that hard work means a hearty appetite. The effect of muscular work on food consumption is plainly shown in dietary studies carried on with Maine lumbermen, who, while engaged in chopping and yarding, ate food supplying 221 grams protein and 8,140 calories per day. These men were engaged in very severe out-of-door work in a decidedly cold climate and the amount of food which they ate is much greater than is eaten by men of similar size on New England farms or in New England factories, who have been found to eat on an average about 100 grams protein and to utilize about 3,425 calories of energy.

It has long been known to physiologists that nitrogen-free nutrients are the chief source of the energy expended in muscular work under usual conditions. It was found that the lumbermen showed a decided partiality for foods rich in carbohydrates and fat, and that the unusually large amount of pastry, sirup, baked beans, and similar foods accounted for the high energy value. The amount of protein supplied by the diet was also high, partly, perhaps, because with the available foods and the previously acquired food habits it would have been difficult to secure a sufficient amount of nitrogen-free material without a correspondingly large amount of protein.

DIETARY STANDARDS.

As a result of the dietary studies which have been made and other data certain dietary standards have been devised which, it is believed, may serve as useful guides for home management. The following table gives such data for a man at moderate muscular work on the basis of food purchased, food eaten, and food digested.

Dietary standard for man in full vigor at moderate muscular work.

	Protein.	Energy.
	Grams.	*Calories.*
Food as purchased	115	3,800
Food eaten	105	3,500
Food digested	95	3,200

It has been found that the waste in the average American home ranges from nothing to as high as 20 per cent of the food purchased. A fair average would be about 10 per cent. In estimating the suggested dietary standards on the basis of food purchased and food eaten, these factors and experimental data on the subject have been taken into account. As shown by the results of a large number of digestion and metabolism experiments, the body assimilates on an average about 92 per cent of the total protein and utilizes about 91 per cent of the total energy of the food consumed. The dietary standard suggested on the basis of food digested takes into account these factors. The energy value also makes allowance for the energy of matter lost in the urine as well as in the feces. These dietary standards differ somewhat from those proposed in earlier publications of the Department, chiefly for the reason that they are based on a larger amount of accurate data than was formerly available.

The fact has always been recognized that the dietary standards proposed were subject to change as information accumulated, and it has been repeatedly stated in Department publications that they were not considered as final and were proposed as guides for home management rather than statements of absolute body requirements.

DIETARY STANDARDS VERSUS PHYSIOLOGICAL REQUIREMENTS.

As will be seen by reference to the table on page 366, which represents the results of a very large number of dietary studies, much variety in protein consumption is noted, more, indeed, than is the case with energy, and this is true, as data would show, whether the comparison is made on the basis of a pound of body material or a square yard of body surface.

Dietary standards should be in reasonable harmony with physiological demands, and it seems probable that such is the case with

those which have been most generally used. That this is true of energy can be shown by the experiments which have been made with the respiration calorimeter in connection with the nutrition investigations of the Office of Experiment Stations. It is obvious that the minimum energy requirement can not be less than the energy output of a fasting man without active muscular work. This value has been found to be as low as 1,550 calories per day for a man of ordinary size. Every muscular movement increases the heat output and hence the energy requirement of the body. A man at ordinary work, such as that of a mason or carpenter, would eliminate at least 1,200 calories of heat in the performance of his work for ten hours, as has been shown by the respiration calorimeter experiments with muscular work of different degrees. This quantity added to the 1,550 calories mentioned above would give 2,750 calories or only 500 less than is called for by the suggested dietary standard; but allowance must also be made for the energy involved in walking to and from work, etc., and for certain internal muscular work of the body, and 500 calories is certainly not an unreasonable allowance for such demands.

The above estimates are believed to be conservative, and it therefore seems apparent that the energy value in the suggested dietary standard is reasonable and in accord with body requirements as experimentally demonstrated.

In the case of protein the question can not be so readily settled, and it seems not unlikely that the amount of protein required varies with different individuals and with the same individual at different times, being influenced by many conditions, some of which are not now understood. That protein requirement is intimately related to the amount of phosphorus, calcium, and other mineral constituents needed seems probable from experiments which have been made with farm animals and from other evidence. In any case it may be said with certainty that there is a minimum quantity of protein without which the body functions can not be carried on and a maximum amount which would be dangerous. The minimum amount has been estimated by a number of observers as about 35 grams per day for a man weighing 150 pounds.

There are reasons for believing that, granted an abundance of carbohydrate and fatty foods of suitable character, and other favorable conditions, the quantity could be still further lowered, but eventually a value would be reached below which a man could not live for long, no matter how much nonnitrogenous material the ration supplied. The upper protein limit has apparently not been fixed experimentally, but it must be fairly large, as some races, notably the Esquimo, must secure large quantities from their almost exclusively animal diet. Many observations have been made in which the amounts consumed were large, 400 to 500 grams per day having

been supplied in some cases. If the entire energy value of the diet were supplied by protein some 750 grams, or 1.65 pounds, would be needed to yield 3,000 calories. Doubtless no one would suggest that either the minimum or the maximum protein value represented the optimum for a man in health living under normal conditions.

Many attempts have been made to learn by observation, experiment, or other method the most satisfactory value, all things considered. The various dietary standards which have been proposed at different times, and the estimates of physiological requirements suggested as guides for daily living by a number of investigators, all fall within the extreme limits referred to above. The fact that there is room for so many different opinions is a clear indication that the question of protein requirement is one which is not as yet thoroughly understood or definitely settled. That the values called for by the commonly accepted dietary standards are rational guides for the feeding of individuals, families, and groups, living under usual conditions, seems to be an opinion which is commonly held.

MINERAL MATTER REQUIRED IN THE DIET.

To be most useful, dietary standards should take into account the amount of ash constituents required by the body, for it is well known that mineral matters of different sorts are essential for use in forming bones and other body tissues for the repair of the body and for other purposes. Many general statements are met with regarding the great importance of mineral matter, and many theories of nutrition have been based to a large extent on mineral constituents. Experimental investigations, particularly physiological studies, along these lines are not very numerous. A recent estimate of the mineral matter required per man per day calls for the following amounts:

Estimated amount of mineral matter required per man per day.

	Grams.		Grams.
Phosphoric acid (P_2O_5)	3 to 4	Calcium oxid	0.7 to 1.0
Sulphuric acid (SO_3)	2 to 3.5	Magnesium oxid	0.3 to 0.5
Potassium oxid	2 to 3	Iron	0.006 to 0.012
Sodium oxid	4 to 6	Chlorin	6 to 8

Other mineral elements, as silica, iodin, and fluorin, are required, but apparently in much smaller quantities. It is doubtful whether a moderate alteration in the absolute quantity or the mutual relation of the ash constituents of foods plays such an important part in nutrition as is sometimes claimed, but there is no doubt that in the long run the body must be supplied with the requisite amount of mineral matter of different sorts, in order that it may be normally nourished. This question is one of the subjects taken up in connection with the nutrition investigations of this Department, and important results,

especially with iron, calcium, and phosphorus, have been obtained. In general, it is evident that the quantities of ash constituents required are small as compared with protein and energy.

The very numerous studies of the ash of different food products reported by agricultural experiment station investigators and others show that nearly all the ordinary foods of both animal and vegetable origin furnish some of the needed ash constituents. There is every reason to believe that with the ordinary mixed diet the body demands for mineral matter may be met, and that when there is for any reason a deficiency of some ash constituent it may be supplied by using certain of our usual foods in greater proportion. For instance, a deficiency of calcium may be met by using larger amounts of milk and cheese, or of iron by larger quantities of green vegetables, fruits, and the coarser milling products of the cereal grains.

ADEQUACY OF THE AVERAGE AMERICAN DIET.

It is interesting to note that the results of dietary studies made throughout the United States do not indicate any probability of general undernutrition. In many cases families were living on a very limited diet that might be much improved as regards the kinds and amounts of food eaten, but such cases were almost exclusively found in studies made with people of such limited incomes that they were living below what has been termed the "poverty line." In the great majority of families and groups which have been studied the food was abundant, though it can be said with equal fairness that there were many opportunities for improvement as regards the rational selection of foods, economical preparation and use, and similar lines.

That persistent overfeeding is harmful no one would deny. That grave errors may also attend the long-continued use of a diet which is markedly deficient especially in nitrogenous material seems clear from the conditions noted in families or larger groups forced by circumstances to live for long periods of years on such a diet. It seems almost invariably the case that such persons are in less satisfactory physical condition and have a lower productive capacity for useful work than similar families and groups living under more generous conditions. As an instance may be cited poor families studied in New York, whose diet was limited and whose physical condition was much inferior to that of families similarly situated except for a more generous diet.

The numerous inquiries made under State or Government auspices into the question of physical deterioration and the almost unanimous conclusion that it is connected with undernourishment give additional point to the view that a reasonably generous diet is desirable.

The question of physical deterioration, which has attracted attention in Europe and has been much discussed in relation to undernutrition, can not be raised with reference to our people as a whole. A large capacity for useful labor and a high average as to the grade of work performed are conceded to Americans by careful students of this subject in this country and elsewhere. The comparatively high standard as regards family and community hygiene and sanitation, and other similar factors, undoubtedly have a bearing on these questions, but no one can doubt that diet exercises an influence, certainly not inferior to any other single factor, and the American diet as a whole is liberal.

KINDS OF FOOD EATEN IN AMERICAN HOMES.

Owing to wide range in climate and agricultural conditions, the United States yields food products in great variety as well as in great abundance. Methods of transporting, storing, and distributing food products have kept pace with improved methods of cultivation, and perhaps at no time and in no country has there been a greater variety of products of the farm, field, ranch, and garden from which to select than in the United States to-day.

In connection with the dietary studies which have been made under the auspices of this Department, data have been summarized which show the proportionate amounts of different foods which make up the diet of the average American home and the relative proportion of the total nutrients and energy which the principal foods and food groups supply. A summary of such data based on the results of about 400 studies is presented in the table on page 375. As will be seen, the number of foods which may be called staples and which make up the bulk of the diet is small, including, among others, such articles as wheat flour, meat, milk, butter, and vegetables.

It will be seen further that animal and vegetable foods are about equal in rank as sources of protein, some 48 per cent of the total being supplied by animal foods and 52 per cent by vegetable foods, of which 43 per cent is contributed by the cereals. Little fat is furnished by vegetable foods, the group as a whole supplying only 11 per cent of the total amount in the diet. Animal foods and dairy products are the most important sources of fat, milk and cream furnishing 26 per cent of the total fat of the diet and meat, as a whole, furnishing a little over twice as much as all other animal foods. Of the different meats, pork is the most important source of fat. Meats and poultry together furnish about twice as much protein as the other animal foods, and beef and veal together furnish about half of the total amount supplied by the entire group.

Proportion of nutrients furnished by different food materials in the average American dietary.

Food materials.	Total food material.	Protein.	Fat.	Carbohydrates.
ANIMAL FOODS.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Beef and veal	7.2	16.7	13.2	----------
Lamb and mutton	.9	2.1	2.6	----------
Pork, including lard	7.2	9.3	42.1	----------
Poultry	.7	1.6	.9	----------
Total meats	16.0	29.7	58.8	----------
Fish	1.8	3.5	1.0	----------
Eggs	2.1	4.1	2.9	----------
Butter	1.6	.3	16.6	----------
Cheese	.3	1.0	1.1	----------
Milk and cream	16.5	8.7	8.0	3.6
Total dairy products	18.4	10.0	25.7	3.6
Unclassified animal foods	.2	.2	.2	.3
Total animal foods	38.5	47.5	88.6	3.9
VEGETABLE FOODS.				
Wheat flour, patent	12.2	19.4	1.5	25.6
Wheat flour, entire	.1	.1	----------	.2
Wheat flour, graham	.1	.2	----------	.2
Wheat preparations	.3	.5	.1	1.0
Wheat bread, patent	5.8	8.1	1.6	12.4
Wheat bread, entire	----------	----------	----------	.1
Wheat bread, graham	.1	.1	----------	.2
Crackers	.3	.5	.5	1.0
Sweet cakes, etc	.6	.8	.9	1.4
Corn meal and flour	8.7	10.1	3.8	13.7
Corn preparations	.2	.2	.1	.4
Oatmeal and preparations	.5	1.0	.5	1.1
Rice	.3	.3	----------	.9
Rye	1.3	1.6	.1	3.1
Barley and buckwheat	.1	.1	----------	.5
Total cereals	30.6	43.0	9.1	61.8
Sugar, molasses, etc	5.4	----------	----------	17.5
Starch (prepared)	----------	----------	----------	.1
Dried legumes	1.0	2.9	.2	1.7
Fresh legumes	.6	.4	----------	.3
Tubers and yams	12.5	3.8	.3	8.3
Other vegetables	6.2	1.6	.5	1.7
Total vegetables	20.3	8.7	1.0	12.0
Fresh fruits	3.8	.3	.3	2.5
Dried fruits	.6	.2	.1	1.2
Total fruits	4.4	.5	.4	3.7
Nuts	----------	----------	.1	----------
Unclassified vegetable foods	.5	.1	.2	.6
Total vegetable foods	61.2	52.3	10.8	95.7
Miscellaneous food materials	.3	.2	.6	.4
Total food materials	100.0	100.0	100.0	100.0

The table on page 375 does not show the relative amounts of the different foods which are expensive and which may be classed as luxuries rather than staples, but it is obvious that such foods do not supply a very large proportion of the total nutrients and energy, since the groups (e. g., "other vegetables," "fresh fruits," etc.) in which many are included are not large factors in the totals.

VARIETY IN DIET IN RELATION TO COST.

In general it may be said that, other things being equal, the cost of the daily food is determined by the proportion of the total expended for such staple articles as bread, meat, butter, eggs, and common vegetables, and the expenditure for accessory foods, such as expensive fruit, out-of-season vegetables, fancy sweets, etc., which, as ordinarily used, contribute more to the attractiveness of the diet than they do to its nutritive value. As an instance, may be cited the results obtained with a workingman's family in New Jersey in comfortable circumstances. The total expenditure for food during the period covered by the dietary study was $34.95. Of this, $5.16, or 14.8 per cent, was paid for oranges and celery, which together furnished only 150 grams protein and 6,445 calories of energy or about 1 per cent of both total protein and total fuel value. During the same period the expenditure for cheaper vegetables and fruits, such as potatoes, cabbage, sweet potatoes, apples, canned tomatoes, canned peaches, etc., was $5.75, and this supplied 1,909 grams protein and 58,000 calories of energy. The expenditure of $5.16 for cereal foods and sugar furnished 3,375 grams protein and 184,185 calories of energy, or about 25 times the amount supplied by the celery and oranges. The oranges and celery undoubtedly added to the attractiveness of the diet, and nothing can be said against their use provided the cost of the diet is reasonable in proportion to the family income. It is true, however, that such foods could have been omitted from the diet without materially changing its nutritive value, while the cost of the daily food would have been considerably lowered; or other articles perhaps equally attractive but of lower cost might have been used in place of the oranges and celery.

It is in the combination, with due reference to economy, of staple articles, many of which are lacking in distinctive flavor, with foods and dishes which possess marked flavor that one of the greatest opportunities for skillful management in the household occurs.

Another problem of importance is the ease and economy of preparation of food in relation to its cost. A cheap cut of meat, like shoulder clod, can not be so readily served in attractive form as a choice steak. The cheaper cut requires much longer cooking and consequently more fuel and labor, and to be at its best should be cooked with seasoning vegetables or prepared in some similar

way which secures flavor. Other cases like this are too well known to need mention. True economy consists in so adjusting such matters to the family income that palate and purse may each have its due.

The housewife who can appreciate and apply the available knowledge regarding the relative cost of different methods of cookery, fitting combinations of food, the relation between composition and cost, and similar factors can supply wholesome diet suited to her family needs at a much more reasonable cost than is the case when such knowledge is disregarded.

IMPORTANCE OF SCIENTIFIC DATA IN HOME MANAGEMENT.

Many housekeepers are very wise in questions of home management and understand the art of housekeeping so well that they secure the desired results with the empirical knowledge gained by experience and handed down from mother to daughter. The problems pertaining to food and diet have received a very large amount of study during the last fifty years, and the explanation of many facts on which empirical knowledge was based has been learned, and there is now a large body of valuable information, much of which has been so systematized that it can be readily taught. That this is the case is shown by the large number of high schools and other educational institutions which give courses in home economics and the success which has attended this kind of teaching. It is certainly true that system and coordination can be taught with respect to the purchase of food and the management of dietetic problems in the same way that they can be taught with reference to manufacturing problems or other business enterprises. In both cases, some of the facts systematized and arranged have been newly acquired by experimental study, while others are the result of experience and are as old as the race.

The problems of economy in living differ in town and country. The farmer's wife has her vegetables, fruits, poultry, dairy products, etc., without a cash outlay, while the housewife in the city must purchase everything. Considering market facilities, however, and the prices which must be paid for many staple and fancy foods, the advantage with respect to such foods seems to lie with the careful buyer in the large town or city. The small town with its garden and other opportunities for home production of food products is, of course, midway between the city and country. Each region has its attractions and its special advantages, but the underlying principles with respect to economical home management are the same in every locality. It is with a view to helping the producer to provide the food supplies which are most needed and the housewife to solve her problems that studies of the kind and amount of food eaten, the relative nutritive value of different foods, the comparative economy

of different methods of cooking, and related questions have been undertaken by this Department.

CONCLUSION.

An extended survey of the literature of food supply and the food habits of many races makes it plain that in no country is there a greater variety of readily accessible foods of good quality than in the United States and in none is there a more general use of a wide range of articles. Thanks to our varied climate, our ready means of transportation, and our facilities for marketing and handling food products, the contributions of any given locality are readily accessible in other regions. Skill in selecting from this great variety of food products and in the preparation of foods after they are purchased is essential if out of our abundance a diet is to be secured which is best suited to the needs of the American people. The dietary studies herein summarized and other similar reliable data seem to show that the people of the United States as a whole are adequately nourished as compared with other races. The acknowledged energy and achievement of the American people, together with their general good health and physical well being, certainly indicate that we have in the main used our food resources advantageously.

THE USE OF THE MICROSCOPE IN THE DETECTION OF FOOD ADULTERATION.

By B. J. Howard,
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INTRODUCTION.

To the lay mind the statement that the microscope may be of use in the examination of food and drug products is a new idea and one which often calls forth many queries. It can be readily understood how gross adulteration may be detected by a simple magnifier, as, for instance, when foreign seeds, gravel, or powdered rock have been mixed with whole small spices. The adulterant may be of such character as easily to escape the notice of the ordinary buyer, though with even a small lens or reading glass the foreign substance may be seen to be very different from the true spice. One case recently brought to the attention of the Bureau of Chemistry was a sample of celery seed adulterated with nearly 40 per cent of powdered rock, the color and size of the rock particles being such as to be easily overlooked in a casual examination. A small magnifier, however, made the difference very apparent. Figure 1 of Plate XLVII, though magnified only 6 diameters, shows plainly the difference between the regular-shaped celery seeds and the angular rock particles.

The usefulness of the simple magnifier in examining food and drug materials, however, is of limited application, and for the examination of products which are made up of small particles, such as flour, ground spices, and powdered drugs, has little or no value. In such cases recourse must be had to the compound microscope with a magnifying power ranging from 50 to 400 diameters.

Although a large amount of work has been done by various investigators on the application of the microscope to analytical work, there are certain parts of the field as yet almost untouched and new problems are constantly being presented for solution. Analytical work was formerly conceived to consist only of test-tube and blast-lamp methods, but the constantly increasing complexity of the questions arising makes it necessary that the analyst should call to his aid physical and microscopical tests as well as those considered strictly chemical.

STARCH PRODUCTS.

Among the products important from a commercial as well as an analytical point of view those consisting partially or wholly of starches are most easily examined and identified. The world's supply of starch comes for the most part from a limited number of plants—12 or 15 include nearly all that are of much commercial importance. To the naked eye these starches all appear as a fine white powder, but under a microscope grains or granules are seen which vary more or less in shape, size, rings, hilum (nucleus), and action toward polarized light.[a] Some of the grains are almost spherical, others are angular or ovoid, and still others are very irregular in outline. In diameter they vary from one-tenth to one-thousandth of a millimeter. Our common starches, such as potato and rice starches, are good examples of variety in form and size, though neither of these quite reaches the limits sometimes found. These starches are shown on Plate XLIV, figures 1 and 2, which illustrate strikingly two typical variations in shape. In the case of potato starch the grains are large, with smooth outlines, while rice starch has small grains with angular outlines.

In no variety are all the starch grains of one size, but usually there are fairly well defined limits. An illustration of the way they sometimes vary in size in a given variety is demonstrated in the case of wheat starch (Pl. XLIV, fig. 3), where all gradations of grains from very small to quite large are represented. Most of the grains show, more or less clearly, fine lines of rings upon the surface. In some varieties these are arranged concentrically, while in others they are eccentric.

A hilum whose form and position varies widely in certain species commonly occurs in starches. In some it is at the center, as in corn and wheat starches, in others near one end, as in potato and arrowroot. When viewed in polarized light starches show more or less strongly a cross with the bars passing through the hilum. Some of the most striking examples of the action of polarized light on starches are illustrated on Plates XLIV and XLV. Wheat starch (Pl. XLIV, fig. 4) has a central cross, while in maranta (arrowroot, fig. 5) it is eccentric and well defined. Bean starch (fig. 6), which illustrates

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[a] Polarized light is light that has been modified in such a way that all of the waves vibrate in one plane. There are several means by which this can be accomplished, but the most convenient one for the microscope is by the use of the Nicol prism. Light which has been thus polarized is acted upon in a very characteristic way by various crystalline bodies and by the walls and contents of some plant cells having peculiar physical structures. This is strikingly shown in the case of the starches illustrated on Pl. XLIV, figs. 4, 5, and 6, and Pl. XLV, fig. 1.

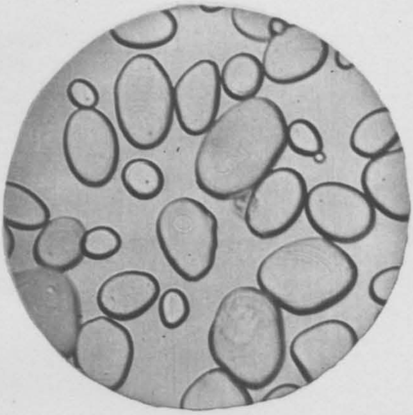

FIG. 1.—Potato Starch.

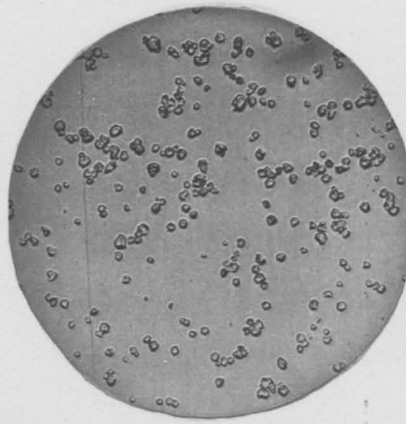

FIG. 2.—Rice Starch.

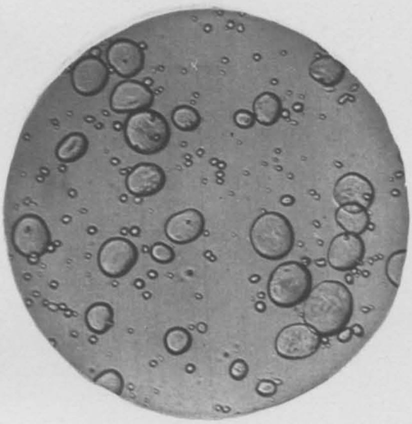

FIG. 3.—Wheat Starch.

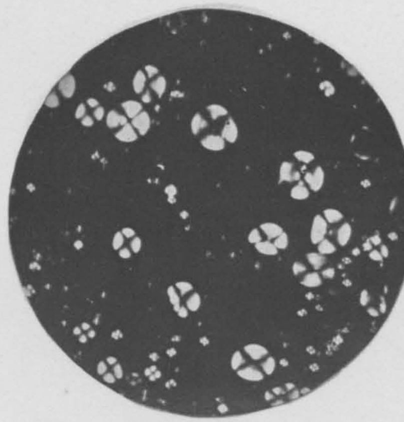

FIG. 4.—Wheat Starch, Under Polarized Light.

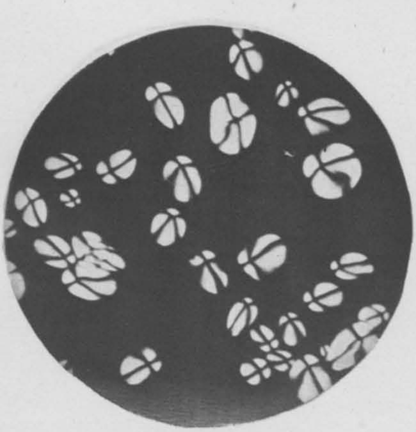

FIG. 5.—Maranta Starch—Polarized Light.

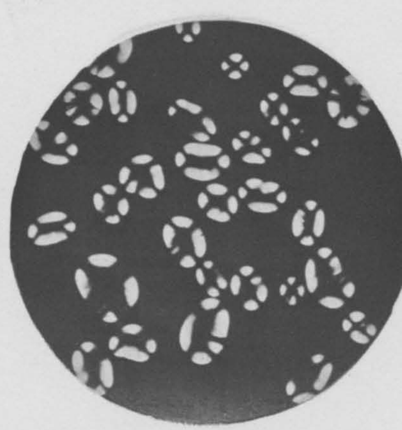

FIG. 6.—Bean Starch—Polarized Light.

SOME COMMON STARCHES (×200).

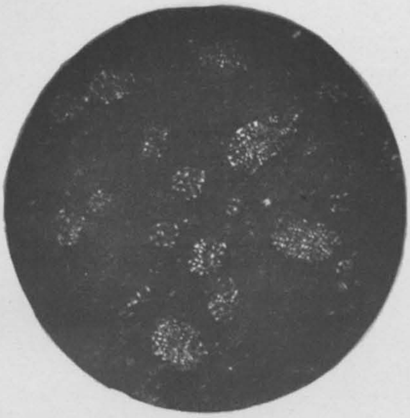

FIG. 1.—Oat Starch, under Polarized Light. (×200.)

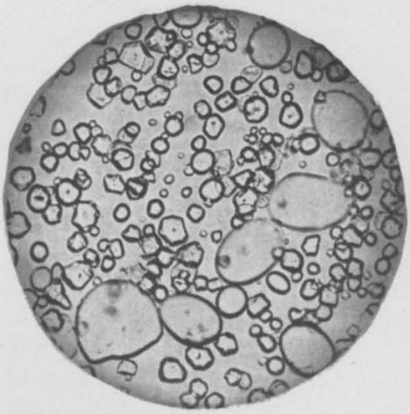

FIG. 2.—Potato Starch, Adulterated with Corn Starch. Rounded Grains, Potato; Angular Grains, Corn. (×200.)

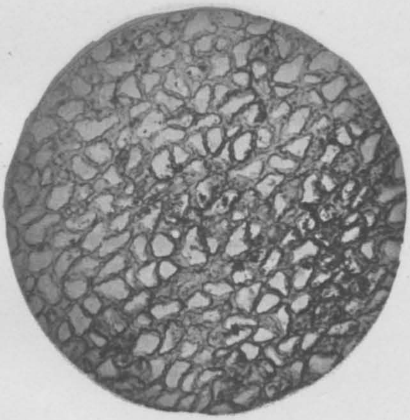

FIG. 3.—Section of Coffee Bean showing the Beaded Structure of the Cell Walls. (×80.)

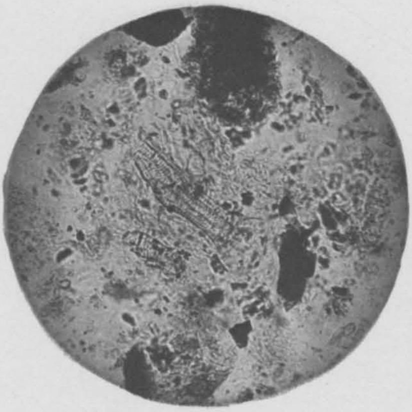

FIG. 4.—Chicory, showing some of the Characteristic Sap Vessels by which it is Detected when Present in Coffee. (×80.)

STARCH AND COFFEE ADULTERATIONS.

the leguminous type, has a spindle-shaped cross. In the oat a number of starch granules are joined together, forming a mass. When these masses of starch are examined under polarized light the individual grains in the mass have their own individual effect and interfere so with each other that there results little more than a hazy glow of light. (Pl. XLV, fig. 1.)

By becoming familiar with all these characteristics it is possible to identify with considerable accuracy nearly all of the commercial starches. Potato starch adulterated with cornstarch, wheat with corn flour, and buckwheat with wheat are examples of those most easily detected. Thus in Plate XLV, figure 2, is shown a picture of potato starch adulterated with a considerable amount of cornstarch. The grains of the latter are easily distinguished by their angular form.

SPICES.

Another interesting application of the microscopic method of food analysis is found in the examination of spices. Many of these naturally vary so widely as to ash, fiber, etc., and in taste that it is impossible to detect certain kinds of adulteration by chemical and physical means alone. A study of the structure of pure samples will usually fit the analyst to detect adulteration in the ground spices as well as to identify the adulterant used. In order to work most intelligently, however, it is imperative that the analyst should have a good foundation in histological botany, since in this class of products the plant cell in its various modifications becomes the means of identification. In an examination of this sort nearly all kinds of plant tissue are to be considered, because some spices are derived from roots or rhizomes (as ginger), some from barks (as cassia and cinnamon), some from flowers (as cloves), some from seeds (as mustard), some from fruits (as red pepper, black pepper, etc.), and some (such as sage and thyme) from leaves.

Fortunately most of the substances used for adulteration have a structure very different from the genuine spices. For example, although pepper adulterated with ground peas or beans may not always be detected by chemical means, especially when olive pits or pepper shells have been added to counteract the excess of starch present in peas, a microscopical examination will reveal such adulteration at once by showing the presence of the large starch grains characteristic of certain legumes. In pepper the starch is present in angular masses made up of small grains. A sample of this kind of adulteration is shown in Plate XLVI, figure 1, in which the angular masses of pepper are easily distinguished from the nearly ellipsoidal bean-starch grains.

It sometimes occurs that a manufacturer has added so large an amount of corn meal or foreign ground shells and fruit stones to a pepper as to make the adulteration apparent to the taste by the lack of pungency, which is often corrected by adding a small amount of cayenne pepper. A sophistication of this kind can be readily detected by the microscopic method of analysis, because the tissues added are so distinctly different from normal pepper tissue. In figure 2 of Plate XLVI is shown the microscopic appearance of a sample of pepper which was grossly adulterated with ground olive stones. The starchy material has been stained black in the picture, while the partly clear portions, more or less oblong in form, are the stone cells of the olive pits.

The capsicum fruits are readily identified by means of certain cells found on the inner portion of the pericarp (pod) and others on the seed coats. These cells have characteristic sinuous outlines which make them easy to detect even when present in very small numbers. (Pl. XLVI, fig. 3).

Sometimes cayenne is adulterated with colored corn flour and ground wood. Plate XLVI, figure 4, shows a sample of such an adulterant composed principally of powdered sawdust, the fibrous character of the wood differentiating it clearly from the pepper.

COFFEE AND CHOCOLATE PREPARATIONS.

In coffee and chocolate preparations roasted chicory, cereals, and peas in the case of the former, and starchy materials and cocoa shells in the case of the latter, are sometimes used for adulteration. Coffee, being the seed of a plant, has a structure which is very different from chicory, which is a root. The cell walls of coffee have a characteristic beaded appearance which is present in but few other seeds (Pl. XLV, fig. 3.). Even after roasting and grinding these beads can be easily distinguished, while chicory contains sap vessels by which it can be detected (Pl. XLV, fig. 4).

Chocolate and cocoa are made from the seeds of the cocoa plant, to which foreign starches are sometimes added. From the best grades of these products the shells are removed, but in the poorer grades the shells are left and even additional ones are sometimes added. Cocoa beans contain naturally a considerable amount of starch. The grains are small in size and are easily distinguished from the starchy adulterants, such as corn and wheat flours, or potato, corn, and arrowroot starches. An artificial chocolate coating has been examined which was composed of cocoa shells, cornstarch, beef tallow, and some mineral matter, probably used as a coloring substance.

FIG. 1.—Black Pepper, Adulterated with Bean Flour. The Angular Portions are Pepper Starch, the Rounded Bodies Bean Starch. (×200.)

FIG. 2.—Black Pepper, Adulterated with Ground Olive Stones. The Pepper Starch has been Colored Black with Iodin, Causing the Olive Cells to Appear in Contrast. (×150.)

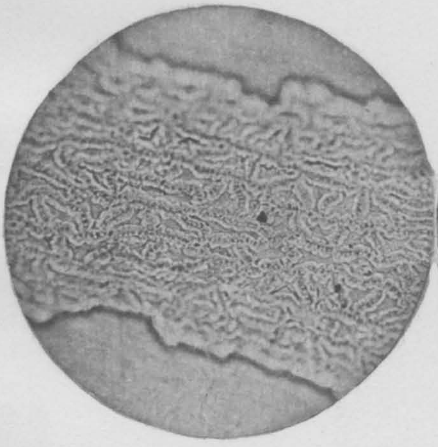

FIG. 3.—Cayenne Pepper. Characteristic Sinuous Cells from Inner Portion of Pod. (×150.)

FIG. 4.—Adulterant for Cayenne Pepper Composed Largely of Powdered Sawdust. (×80.)

PEPPERS AND SOME ADULTERANTS.

FIG. 1.—Celery Seed, Adulterated with Ground Rock Fragments, the Latter Identified by their Angular Form. (×6.)

FIG. 2.—Diatom Shell Obtained from Artificial "Lemon Slices" and Indicating the presence of Agar-Agar. (×420.)

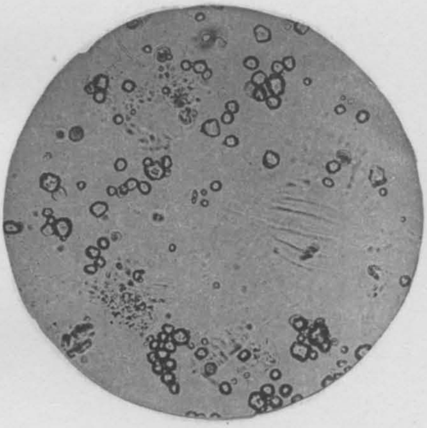

FIG. 3.—Cream Thickener, Composed of Corn Starch (Angular Bodies) and Gum Tragacanth (Laminated Portions). (×150.)

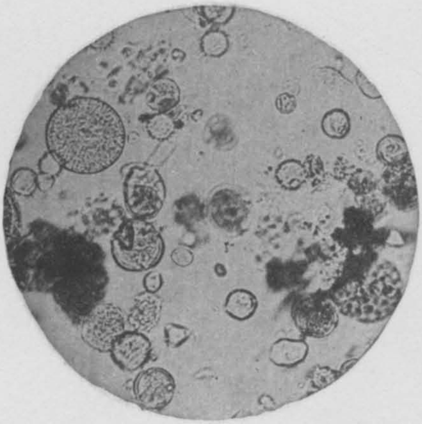

FIG. 4.—Pollen from Honey. Shows by Various Forms the Different Plants Visited by the Bees. (×200).

SOME CURIOUS TYPES OF ADULTERATION.

JELLIES AND JAMS.

In the production of artificial jellies, jams, and some kinds of confections, various thickeners are used, among which might be mentioned gelatin, starch, agar-agar, gum tragacanth, and gum arabic. Some of these are difficult of identification, while others can readily be detected. Agar-agar is a product made from certain seaweeds and usually contains the siliceous shells of diatoms. These shells are characteristic and quite easily detected in the sediment from the bottom of a dish after the material has been digested with dilute nitric acid. Plate XLVII, figure 2, shows such a diatomaceous shell obtained from a sample of artificial "lemon slices" in which it was found that the jellying material used was agar-agar.

Starch can easily be detected by microchemical and microscopic tests. Gum tragacanth and some other gums of this class contain a certain amount of small starch grains. When allowed to swell in water a delicate laminated structure is developed by which these gums are disclosed even in such products as ice cream and marmalades.

CREAM.

A sample of thickener for cream composed of cornstarch and powdered gum tragacanth is shown in Plate XLVII, figure 3, and illustrates this feature quite satisfactorily. In this case the cornstarch is shown plainly as the angular particles, while the striated bodies near the center of the field are swollen fragments of the gum.

EDIBLE FATS.

The microscope is also of service in the examination of certain edible fats. Thus if pure lard is dissolved in ether and the latter is allowed to evaporate slowly under proper conditions, crystals of the lard will be formed. These if normal will appear under the microscope as narrow plates with chisel-shaped ends. Beef fat treated in a similar manner will normally crystallize out in sheaf-like tufts of crystals the ends of which are nearly or quite needle-like.

HONEY.

Another application of microscopic analysis is in the identification of the flowers from which honey is made. This is of practical value in the analysis of honeys purporting to be from certain flowers. Although bees will almost invariably gather honey from several kinds of flowers, sometimes one or another of these predominate to such an extent as to impart a distinctive color and taste, enough to allow the

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honey to be called by that name. By microscopic examination it is readily ascertained whether a so-called apple-blossom honey or an orange-blossom honey is really largely derived from the source claimed. Plate XLVII, figure 4, shows several kinds of pollen found in an ordinary sample of honey.

Another application of this study of pollens is in locating in some cases the geographical origin of the product. This is made possible by the fact that many of the plants from which honey is obtained grow in comparatively limited geographical areas. Thus it is manifest that pollen from the orange tree would not be found in a honey made in any of the States except those of the southern or southwestern part of our country. It is sometimes possible to determine in this way whether a product is true to label as regards the part of the country in which produced.

Though only a few of the more obvious forms of adulteration have been discussed, for the field has as yet been only partly explored, they may serve to illustrate how the microscope comes to the aid of the chemist when he endeavors to detect fraud in foods and food products.

CROPPING SYSTEMS FOR STOCK FARMS.

By W. J. Spillman,

Agriculturist in Charge of Farm Management Investigations, Bureau of Plant Industry.

ROTATION DEFINED.

A rotation of crops is a succession of crops, one following another on the same land. If these crops continually recur in a fixed order, the rotation is a definite one. If they recur at regular intervals, the rotation is said to be a fixed rotation. A definite rotation may not be a fixed rotation; for example, in many parts of the country it is customary to leave grass lands down from three to six or more years, the length of time depending on the condition of the sod, the supply of labor, feed requirements of stock, etc. When the sod is plowed up, the land is planted in corn, then wheat is sown, and grass follows. This rotation is perfectly definite as to the crops grown and the order in which these crops follow each other, but it is not fixed as to the number of years it occupies.

Fixed rotations are not objectionable on farms that grow crops for sale, provided, of course, the crops are such as bring a satisfactory profit and proper measures are taken to conserve the fertility of the soil. We shall later see also that fixed rotations are practically necessary on certain types of stock farms where one or more of the crops in the rotation are used for pasture, and where, consequently, the fields must be separately fenced. But a single fixed rotation practically never produces crops in the needed proportions on a stock farm. Hence, the stockman who runs a single fixed rotation covering his whole farm practically always has a surplus of some kinds of feed or a shortage of others. For this reason he is compelled to keep less stock than his farm would support with a properly planned cropping system unless he is in a position to buy feed that may be lacking. This will be made plainer when we come to plan cropping systems for stock farms later in this article.

A cropping system may consist of one or more rotations or it may not contain a rotation at all. For instance, on the farm of Mr. J. T. McDonald, described in Bureau of Plant Industry Bulletin No. 102, the cropping system is a perfectly definite one. One hundred acres of rocky hillside is in permanent pasture and 100 acres of valley land is in permanent or semipermanent meadow. Each year about 10 acres of this meadow land which most needs reseeding is plowed up for corn and then put back to grass again.

Again, on the farm of Mr. J. E. Wing, of Ohio, there is a definite cropping plan which includes a definite but not a fixed rotation. The plan is to keep all the land possible in alfalfa. When an alfalfa field needs reseeding it is plowed up for corn, which is followed by alfalfa sown with bald barley as a nurse crop. This cropping system is admirably adapted to the type of farming followed. Mr. Wing buys western lambs and feeds them during the winter. The amount of hay produced is variable from year to year, and the number of lambs purchased varies accordingly. What corn is needed in addition to that raised is bought. When an alfalfa field is plowed up on this farm it is run through a definite rotation back to alfalfa again.

On still another farm the cropping system consists of (1) permanent pasture; (2) a three-year rotation of corn, grass, grass; and (3) a one-year rotation consisting of wheat and vetch in winter and cowpeas in summer.

EXAMPLES OF SIMPLE AND COMPLEX ROTATIONS.

While a single fixed rotation produces crops in fixed proportions, except for variations in yield, and is thus inflexible, two rotations can nearly always be so arranged as to produce any given crops in any desired proportion. Suppose, for instance, that a dairy farmer desires to produce annually 15 acres of corn for silage, 20 acres of corn for grain, 25 acres of oats for grain, and 60 acres of hay. He can do this by arranging two three-year rotations as follows:

A system of two simple rotations on a dairy farm.

First series.		Second series.	
First year	35 acres corn.	First year	5 acres pea and oat hay.
Second year	25 acres oats. 10 acres pea and oat hay.	Second year	5 acres timothy and clover hay.
Third year	35 acres timothy and clover.	Third year	5 acres timothy and clover hay.

This gives the exact acreage of each crop desired. If, in the above cropping system, the area of oats exceeds that of corn, the requirements being, say, 20 acres of corn, 25 acres of oats, and 60 acres of hay, we can arrange the rotations as follows:

A second system of two simple rotations on a dairy farm.

First series.		Second series.	
First year	20 acres in corn for grain. 5 acres in a hay crop.	First year	10 acres in peas and oats for hay.
Second year	25 acres in oats for grain.	Second year	10 acres in timothy and clover for hay.
Third year	25 acres in timothy and clover for hay.	Third year	10 acres in timothy and clover for hay.

The general plan in the foregoing scheme of two rotations is to fill in the vacancies of the first and more usual rotation by putting in some other crop which is grown mainly in the second rotation. The scheme is therefore an elastic one, well suited especially to dairy farms on which the pasture is provided outside of the regular rotations.

There is always a way of planning a single complex rotation which has the same elasticity as the two-rotation systems before outlined and which is even better than the two-rotation system on most farms. The two systems given before may be arranged as follows:

Combination of the foregoing two-rotation systems into single complex rotations.

	First system.		Second system.
First year	35 acres in corn for grain. 5 acres in peas and oats for hay.	First year	20 acres in corn. 15 acres in peas and oats for hay.
Second year	25 acres in oats for grain. 10 acres in peas and oats for hay. 5 acres in timothy and clover for hay.	Second year	25 acres in oats. 10 acres in timothy and clover for hay.
Third year	40 acres in timothy and clover for hay.	Third year	35 acres in timothy and clover for hay.

The first of these complex rotations gives the same acreage of each crop as the first set of two rotations previously given, and the second the same as the second set of two rotations. While these last two rotations are technically called complex rotations, they form systems which are really simpler than the two-rotation scheme, and we generally use rotations of this type in planning cropping systems for dairy farms.

This type of rotation is exceedingly elastic. It not only permits each crop to be grown in exactly the proportion needed, but it can be varied in many ways by substituting other crops for those shown in the outlines above. For instance, in the first of these complex rotations, instead of plowing up the whole 40 acres of timothy and clover, we may leave 5 acres to take the place of the peas and oats in the first year. This 5 acres may remain down indefinitely, as long as the yield is satisfactory, and when necessary it may be plowed up and sown to peas and oats, to be followed by timothy and clover again without losing a crop of hay.

Again, we may sow 10 acres of timothy and clover in the cornfield of year 1 to take the place of the 10 acres of peas and oats in year 2. Similar modifications may be made in the second complex rotation.

This is exactly the type of cropping system that has been developed by the shrewd New England dairy farmer whose small holdings will not permit him to grow a fixed, inelastic rotation that does not produce the crops in the proportion in which he wants them. Such a system enables the farmer to keep a maximum herd on his farm.

It is, of course, recognized that variation in yield from year to year will cause considerable variation in the quantity of each crop produced. This variation is especially likely to occur on poor soils; it is much less on farms that have exceedingly rich soil. Nevertheless, the farmer is compelled to lay some kind of plan for meeting such variations in yield. Any scheme has value if it enables the farmer to approach more nearly to the ideal of his plans, and cropping systems like the complex rotations outlined will do this.

LACK OF AN ANNUAL HAY CROP IN MIDDLE LATITUDES.

The cropping schemes outlined are greatly superior to the common form of rotation found generally on stock farms in the southern half of the timothy and clover region. Here almost every stock farm inserts wheat, and sometimes oats also, in the rotation between corn and grass. The writer meets no question oftener than this: "What can I substitute for oats in my rotation? They are not a satisfactory crop here; they fail too often." When you ask such a farmer why he grows oats he will say: "Well, I don't like to sow wheat after corn. It doesn't do well. Besides, we don't cut our corn for fodder any more, as it doesn't pay, and we can't sow wheat after corn unless we cut it for fodder." Then when you ask if he finds wheat a paying crop, he will reply: "No, I don't make anything from it, but I have to have a place to sow grass, and then we need the straw for bedding." Thus, thousands of farmers sow oats, which fail three times out of five and pay little or no profit when the crop succeeds, and then sow wheat, which is ordinarily not profitable, or at least only moderately so on stock farms in the section referred to; and they do this because they need the straw for bedding and do not know that by proper management they can sow timothy and clover in corn. The writer has seen dairy farms on which one-third of the land was devoted to wheat, merely for the straw to use as bedding, even where there was an actual loss on the crop.

The above considerations emphasize one of the most serious needs on stock farms in middle latitudes in this country. We need a reliable annual hay crop to take the place usually occupied by oats in our rotations. In the more northern States peas and oats fill this need exactly; but neither peas nor oats are reliable in middle latitudes, and we have nothing to take their place. This gap could be filled by a mixture of wheat and vetch sown in the fall, at least on farms where corn is cut

for silage or fodder, but where the cornstalks are left standing a spring crop is a necessity, and we have no satisfactory crop for this purpose.

If we had such a crop we could sow our timothy and clover alone in August after the spring hay crop is off, and get a full crop of hay the next year. There is no longer any question that August is the best time to sow timothy and clover if the season is at all favorable. This does not mean sowing late in September or in October; clover sown so late usually fails, but when sown on a well-prepared seed bed, with plenty of moisture in it, any time in August or even during the first ten days of September, without a nurse crop, clover is a much more certain crop than when sown on wheat or with oats in the spring.

CROPPING SYSTEMS FOR SPECIAL TYPES OF STOCK FARMS.

We shall now proceed to plan a few cropping systems for stock farms to show the principles involved in a system that meets the needs of the farm or permits a maximum number of animals to be kept. The farms selected for this purpose are a horse farm in Virginia, a dairy farm in a northern State, a dairy farm in a middle latitude, and a hog farm in a region a little south of middle latitude. Data are not available for planning cropping systems for farms devoted to beef cattle or to sheep, though such data are accumulating rapidly in the Office of Farm Management Investigations.

A VIRGINIA HORSE FARM.

The horse farm in Virginia contains 1,000 acres of arable land, and the owner desires to maintain 16 head of work horses, 4 stallions, and 80 brood mares. About 50 colts are raised annually, but all the feed for them is bought. These colts are highly bred and sell at high prices, and the best feed obtainable is bought, regardless of cost. While the farm could easily feed all this stock, including the colts, the plans have been drawn in accordance with the farmer's wishes, and are given here nearly as originally drawn. We have no record of the feeding system of the colts, and they are left out of consideration in what follows.

The system of feeding which it is proposed to follow on this farm is as follows:

Mares: At pasture six months; during the remaining six months the daily feed is estimated at 15 pounds of hay and 12 pounds of grain, one-third of which is corn, the other two-thirds being bought.

Stallions: Daily feed the year round, 15 pounds of hay and 12 pounds of grain, one-third of which is corn, the other two-thirds to be bought.

Work horses: Average daily feed for the year, 14⅝ pounds of corn and 15 pounds of hay.

The bedding required—100 tons—is to be bought, the estimated price being $5 a ton.

Sufficient hay is to be grown to furnish what is needed by the mares, stallions, and work horses and enough additional hay to be sold at an estimated price of $12 a ton to buy all the bedding ($500 worth) and the 63⅓ tons of bought grain, estimated to cost $25 a ton, making a total of $2,075 worth of hay grown for sale, or 173 tons.

From the above data the following table is calculated:

Feed needed on a 1,000-acre horse farm in Virginia.

Crop requirements.	Hay.	Corn.[a]	Bought grain.
	Tons.	*Tons.*	*Tons.*
Feed for—			
80 mares	108	28.8	57.6
4 stallions	11	2.88	5.76
16 work horses	44	42.00	--------
Hay to sell	173	--------	--------
Total	336	73.68	63.36

[a] Shelled corn, a ton being equivalent to 35.7 bushels, or 7.14 barrels.

Estimating hay to yield 1⅓ tons per acre and corn 40 bushels per acre, the total acreage required is 252 acres of hay and 65.8 acres of corn. To be on the safe side, let us provide 75 acres of corn and 275 acres of hay. In a three-year rotation, three 75-acre fields may be employed, corn being followed by timothy and clover for two years, the timothy and clover being sown in the corn in August. This gives 150 acres of the 275 acres of hay needed. As an experiment, another 10 acres is to be devoted to wheat and vetch in the winter and soy beans or cowpeas in summer. This will undoubtedly produce more than 1⅓ tons of hay per acre, but we may add the excess to our factor of safety.

We must still provide for 115 acres of hay. This is done by plowing up each year 115 acres of old, unproductive pasture and sowing to timothy and clover in August, without a nurse crop. This will give a good crop of hay the next year, and will furnish good pasture for two or three years more. It is estimated that the first year this hay land is used for pasture 3 acres of it will be sufficient for a mare and her colt. The 115 acres will therefore furnish pasture for 38 mares. A mare and her colt require 5 acres of old pasture, and the 42 remaining mares will require 210 acres. The total acreage required is therefore as follows: Three-year rotation, 225 acres; one-year rotation, 10 acres; hay on old pasture land, 115 acres; pasture

after hay, 115 acres; old pasture, 210 acres; making a total of 675 acres. This leaves 325 acres of the thousand for other uses.

In view of the fact that there is here a surplus of land, it would be wise to introduce wheat into the rotation above given, as the straw would be useful for bedding and the grain could be sold instead of hay. The owner of this farm estimates that wheat would yield 20 bushels of grain and 1 ton of straw per acre. Seventy-five acres of wheat would thus produce 75 tons of straw, worth $375, and 1,500 bushels of grain, worth $1,200; in all, $1,575. Without the wheat crop the amount of hay raised for sale was 173 tons, valued at $2,075. With wheat in the rotation the amount of hay that must be sold to buy bedding and grain is $2,075 less $1,575; i. e., $500 worth, or approximately 42 tons. This, added to the amount required for feed, gives 205 acres of hay to be grown. Of this, 150 acres will be grown in the four-year rotation on 75-acre fields of corn, wheat, hay, hay. This leaves 55 acres to be grown outside of this rotation. If we devote 10 acres to wheat and vetch in winter (1 peck of wheat and 5 pecks of vetch per acre), followed by soy beans or cowpeas in summer, we have only 45 acres of hay to be sown each year on run-down pasture land. The second year this 45 acres will furnish pasture for 15 brood mares, leaving 65 mares to find pasture on old grass lands at the rate of 5 acres per head. This will require 325 acres. The total acreage required is therefore as follows:

	Acres.
Corn	75
Wheat	75
Hay	75
Hay	75
Wheat and vetch and soy beans	10
Extra hay	45
New pasture	45
Old pasture	325
Total	725

This will leave a surplus of 175 acres on the 1,000-acre farm.

In this case the surplus is really only 130 acres, for each summer 45 acres of old pasture is plowed up for hay and produces no hay till the next year. If, however, this new seeding be made in August of each year, and if it be used for pasture the next year and cut for hay in June the second year, it could be plowed up and reseeded in August without the loss of a crop. This practice would not be desirable in this case, as it is better to leave the new seeding down as long as it furnishes better pasture than the old grass lands.

Had the problem been to find how many horses could be maintained on this farm, the solution would have been quite different. The solution of this problem requires the use of four unknown quantities, and is too complex to be given here. The answer, however, may be stated. With the yields above assumed, the thousand acres, by growing hay enough for sale to buy all the bedding needed and two-thirds of the grain for the stallions and mares, would support 21 work horses, 6 stallions, and 122 mares.

A NORTHERN DAIRY FARM.

Both roughage and grain are grown on the northern dairy farm. The system of feeding is assumed to be as follows:

Quantities of feed needed for each animal on a northern dairy farm

QUANTITIES NEEDED PER HEAD EACH DAY.

Kind of animal and feeding period.	Length of feeding period.	Pasture.	Grain.[b]	Hay.	Silage.	Skim milk.
	Days.	*Acres.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Cows and bulls[a]	365		6	12	25	
Yearlings:						
May 1 to Oct. 10	163	1		5		
Oct. 11 to Oct. 31	21	1		2	10	
Nov. 1 to Apr. 30	181		2	10	12	
Calves:						
4 months	121		1	4		16
5 months	152	0.5		5		
1 month	31	0.5		3	6	
2 months	61		1.33	10	6	
Horses	365		14	15		

QUANTITIES NEEDED PER HEAD FOR THE YEAR.

Kind of animal.	Pasture.	Corn.	Oats.	Hay.	Silage.
	Acres.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cows and bulls		0.55	0.55	2.19	4.56
Yearlings	1	.09	.09	1.33	1.19
Calves	0.5	.05	.05	.98	.23
Horses		1.28	1.28	2.74	
1 cow and corresponding young[c]	.375	.585	.585	2.76	4.93
1 bull and 3 horses		4.39	4.39	10.41	4.56

[a] The ration assigned for cows and bulls is the average, including dry cows.
[b] Half corn and half oats, by weight.
[c] Half as many young stock as cows, one half of these being calves and the other half yearlings.

The yields assumed are: Silage, 14 tons; hay, $2\frac{1}{2}$ tons; corn, 45 bushels ($1\frac{1}{4}$ tons); oats, 50 bushels ($\frac{4}{5}$ ton).

From the foregoing data we easily calculate the acreage of each crop needed, as follows:

Acreage of each crop needed to support the number of animals stated on a northern dairy farm.

Crop.	1 cow and corresponding young.	1 bull and 3 horses.
	Acres.	*Acres.*
Pasture	0.375	
Silage crop	.352	0.326
Hay crop	1.102	4.175
Corn (for grain)	.468	3.510
Oats (for grain)	.732	5.490
Total	3.029	13.501

Suppose the area of land available is 60 acres. The bull and horses require 13½ acres of this, leaving 46½ acres for the cows and young stock. Each cow, with the corresponding young stock, requires 3.029 acres. The number that can be kept is therefore 46.5 divided by 3.029, or 15.35 cows. Retaining the fraction on this number for good measure, the area of each crop is found to be as follows:

Total acreage of each crop needed on a northern dairy farm of 60 acres.

Crop.	Acreage needed for cows and corresponding young.		Acreage needed for 1 bull and 3 horses.	Total acreage needed for cattle and horses.	
	1 cow.	15 cows.[a]		Exact figures.	Round numbers.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Pasture	0.375	5.760		5.76	5.75
Silage crops	.352	5.403	0.326	5.74	5.75
Hay crops	1.102	16.915	4.175	21.09	21.00
Corn (for grain)	.468	7.184	3.510	10.69	10.50
Oats (for grain)	.732	11.236	5.490	16.73	17.00

[a] The factor 15.35 is used in multiplying.

We now have to arrange these acreages into a cropping system. This we may do as follows:

Scheme of rotation for a northern dairy farm.

		Acres.
Pasture		6.00
Rotation:		
First year	Corn for grain and for silage	16.25
	Peas and oats for hay	1.75
Second year	Oats for grain	17.00
	Timothy and clover for hay	1.00
Third year	Timothy and clover for hay	18.00
		60.00

This is near enough to the actual areas for practical purposes.

A DAIRY FARM IN A MIDDLE LATITUDE.

Grain is not produced on this dairy farm, except that incidentally harvested from corn planted for stover. The system of feeding is assumed to be as follows:

Quantities of feed needed for each animal on a dairy farm in a middle latitude.

QUANTITIES NEEDED PER HEAD EACH DAY.

Class of stock and limits of period.	Length of feeding period.	Pasture.	Soiling corn.	Grain.	Hay.	Corn stover.	Skim milk.
Cows and bulls:	*Days.*	*Acres.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
May 10–Aug. 10	92	2	----------	2	----------	----------	----------
Aug. 11–Oct. 10	61	2	15	2	----------	----------	----------
Oct. 11–May 9	212	----------	----------	6	15	6	----------
Yearlings:							
May 1–Oct. 31	184	1	----------	----------	5	----------	----------
Nov. 1–Apr. 30	181	----------	----------	2	14	----------	----------
Calves:							
4 months	121	----------	----------	1	4	----------	16
6 months	183	0.5	----------	----------	5	----------	----------
2 months	61	----------	----------	1⅓	12	----------	----------
Horses	365	----------	----------	14	15	----------	----------

QUANTITIES NEEDED PER HEAD FOR THE YEAR.

Kind of animal.	Pasture.	Soiling corn.	Grain.	Hay.	Stover.
	Acres.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cows and bulls	2	0.46	0.79	1.59	0.64
Yearlings	1	----------	.18	1.73	----------
Calves	.5	----------	.10	1.07	----------
Horses	----------	----------	2.55	2.74	----------
One cow and corresponding young	2.375	.46	.86	2.29	.64
One bull and 3 horses	2	.46	8.44	9.81	.64

The yields assumed are: Soiling corn, 7 tons; hay, 1½ tons; stover, 2 tons.

Acreage of each crop needed to support the number of animals stated on a dairy farm in a middle latitude.

Crop.	One cow and corresponding young.	One bull and 3 horses.
	Acres.	*Acres.*
Pasture	2.375	2.000
Soiling corn	.066	.066
Hay crops	1.526	6.540
Stover	.320	.320

Let us suppose that the available land is 60 acres and, furthermore, that the cropping system produces three crops in two years—or an average of $1\frac{1}{2}$ crops a year—on all the land except the pasture. The number of cows in the herd is found by substituting in the following formula:

$$\text{Number of cows} = \frac{Nf - (Np + a + b + \ldots + n)}{Np' + a' + b' + \ldots + n'}$$

in which f = the area of land; N = the number of crops per year; p = the area of pasture required by the bull and horses; $a, b, \ldots n$ the acreage of the various crops required by the bull and horses; p' the area of pasture required by 1 cow and the corresponding young stock, and $a', b', \ldots n'$ the area of the various crops required by 1 cow and the corresponding young stock.

Substituting in this formula we have for the number of cows that can be kept:

$$\frac{1.5\times60-(1.5\times2.000+.066+6.540+.320)}{1.5\times2.375+.066+1.526+.320}=14.63.$$

The acreage of each crop required is then—

Total acreage of each crop needed on a dairy farm of 60 acres in a middle latitude.

Crop.	Acreage needed for cows and corresponding young.		Acreage needed for 1 bull and 3 horses.	Total acreage needed for cattle and horses.
	1 cow.	14 cows.[a]		
	Acres.	*Acres.*	*Acres.*	*Acres.*
Pasture	2.375	34.75	2.000	36.75
Soiling corn	.066	.97	.066	1.03
Hay crops	1.526	22.33	6.540	28.87
Stover	.320	4.68	.320	5.00

[a] Factor 14.63 retained in multiplying.

We may now arrange a cropping system as follows:

Scheme of rotation for a dairy farm in a middle latitude.

Permanent pasture, 37 acres.
Rotation:

First year: {6.0 acres of corn for soiling and stover. 5.5 acres of peas and oats, or cowpeas and sorghum for hay.

Second year: {11.5 acres of wheat and vetch, or wheat and crimson clover for hay, followed by 11.5 acres of cowpeas or soy beans for hay.

A HOG FARM IN A REGION A LITTLE SOUTH OF MIDDLE LATITUDE.

The method of managing hogs assumed in the following is adapted to the latitude of Virginia, North Carolina, Kentucky, Tennessee, southern Missouri, and northern Arkansas. It assumes that winter

grain can be made available for pasture practically throughout the winter. When pasture is not available, some clover hay cut from the summer pasture is fed. A small area of soy-bean hay may also be grown for winter feed for the hogs. Fixed rotations are necessary in this type of farming, because each field must be permanently fenced. Experience has shown that with good pasture 10 bushels of corn will, on the average, make a fall pig weigh about 170 pounds by July. The same quantity of corn, with good clover or alfalfa pasture, will carry a spring pig to 190 or 200 pounds by December or January. The pigs are supposed to be fed about all the corn they will eat up clean once a day—late in the afternoon. It will require about 25 bushels of corn to feed a sow on pasture for a year. The sows are supposed to run on pasture with the pigs until the pigs are about ten weeks old. The sows are then removed to their own special pasture, where they are bred, and remain till the next litter of pigs is farrowed. Good winter wheat pasture will carry about 6 pigs to the acre. Good clover pasture will carry 12 pigs to the acre till July, after which it will carry half as many. By sowing wheat and clover in corn in August we get our winter and summer pasture on the same land, so that 1 acre of pasture suffices for 6 fall and 6 spring pigs.

Estimating corn at 60 bushels per acre, 3 horses will require 4½ acres of corn. If hay yields 1½ tons per acre, the horses will require 5½ acres of hay. If a sow produces on the average 14 pigs a year, in two litters, then for each sow kept the requirements are as follows:

Amount and acreage of corn and acreage of pasture needed to support one sow with pigs for a year.

	Acres.
Feed for 1 sow:	
Corn, 25 bushels	0.42
Special pasture	.20
Feed for 14 pigs:	
Corn, 140 bushels	2.33
Pasture	1.17
Total	4.12

Deducting 10 acres required to raise feed for the horses, we have on a 60-acre farm 50 acres to be devoted to hog raising. This divided by 4.12 gives 12.11; i. e., we can keep 12 sows and raise 168 pigs.

The approximate acreage of each crop would be as follows:

Total acreage of each crop needed on a hog farm in a region a little south of middle latitude.

Crop.	For 3 horses.	For 12 sows.	For 168 pigs.	Total.
	Acres.	*Acres.*	*Acres.*	*Acres.*
Corn	4.5	4.85	28.24	37.59
Hay	5.5			5.50
Pasture		2.40	14.13	16.53

Scheme of rotation for a hog farm in a region a little south of middle latitude.

First rotation.	Second rotation.
First year___14 acres in corn + cowpeas.	First year_____6 acres of corn.
Second year__14 acres in corn + wheat and clover.	Second year__3.6 acres of corn; 2.4 acres of hay.
Third year___14 acres in wheat and clover.	Third year___3.6 acres of hay; 2.4 acres of sow pasture.

By feeding a good deal of corn stover to the horses, there ought to be hay enough to feed a cow on this farm. A fair crop of hay may be cut from the pig pasture about the first of July. This hay will contain a good deal of wheat straw, but will answer very well for pig feed in winter. The sow pasture will have to be fenced off each year with a temporary fence.

On account of the variation in yields, in some years there will be more corn than can be utilized, while in other years there will be less than is needed. This is true in all forms of live-stock farming. Some men meet this difficulty by keeping fewer animals than the farm would support with average yields, and thus in good years have some crops for sale. Others meet it by changing the number of animals from year to year to suit conditions. Still others keep a maximum number of animals and buy feed when needed. As before stated, everyone must be his own judge in matters of this kind.

In the system of hog management outlined it is clear that in a section where corn can be bought at a price that permits it to be fed to hogs with a profit, the limit to the number of hogs that can be kept on the farm is the area of pasture that can be provided. With a winter cereal and clover furnishing this pasture, it would be possible to keep half the land in pasture by growing a two-year rotation of corn followed by wheat and clover, these being sown together in August in the corn.

To ascertain the number of hogs 60 acres may be made to support under this last rotation, we deduct the 10 acres required to raise feed for the horses and divide the remaining 50 acres by a divisor obtained as follows:

Acreage for one sow and pigs.

	Acre.
Special pasture for 1 sow	0.20
Regular pasture for 14 pigs	1.17
Corn in rotation with pasture	1.17
Total	2.54

For each sow and her two litters of pigs there is therefore required 2.54 acres. Dividing 50 by this we get 19.7. Retaining the fraction of this number as a factor of safety, the area of the special pasture

for the sows is 4 acres. The area of wheat and clover pasture is 23, and the area of corn 23 acres.

If increasing the area of pasture and buying corn to feed the hogs on this pasture is more profitable than raising the corn, it would also be more profitable to buy feed for the horses. If this is done, to find the number of sows that can be kept we divide 60 acres by 2.54, the result being 23.6. This gives the area of special pasture for the sows as 4.72 acres, leaving 55.28 acres to divide into two fields of 27.64 acres each for the rotation.

Twenty-three sows would produce 322 pigs annually. The amount of corn and hay that must be bought under this system, assuming that the corn raised yields 60 bushels per acre, would be: Hay for 3 horses, $8\frac{1}{2}$ tons; corn for three horses, 270 bushels; for 23 sows and 322 pigs, in addition to corn raised, 2,138 bushels.

In the system of hog farming just outlined difficulty sometimes arises from the fact that when wheat begins to shoot up in the spring it has a deleterious effect on the intestinal canal of the hog. If trouble of this kind is experienced, rye may be substituted for wheat. Along the extreme southern edge of the belt to which this type of farming is adapted winter oats may be used, and these are better than either wheat or rye for hog pasture.

HYGIENIC WATER SUPPLIES FOR FARMS.

By B. M. Bolton, M. D.,
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The importance of a sanitary water supply both for drinking and for purposes of cleanliness has long been recognized, and the improvement in the health of communities which has followed the introduction of abundant supplies of pure water bears testimony to the importance of every precaution in this direction. While the value of a sanitary water supply for cities and towns has thus been demonstrated, too little consideration has been given to the water supplies for farms. Contaminated water used in connection with farm products may affect not only the farmer himself and his immediate family, but all of those who use his products. All the products of the farm which are washed before sending to market and all vessels and containers for food may be made dangerous to health by being washed in polluted water.

There is perhaps no one source of danger so great as that arising from the use of polluted water for washing and rinsing the vessels used for milk. It should be borne in mind that bacteria of various sorts flourish in milk, and that bacteria are the cause of many diseases. Milk is one of the best media for the growth of bacteria, and one drop of polluted water contains enough bacteria for the contamination of almost any amount of milk.

The few drops remaining in the can after it has been rinsed with impure water are sufficient to contaminate all the milk put into the can, and the bacteria introduced into the milk in this way multiply rapidly unless the milk is kept very cold. The danger from polluted milk is not only that there may be microbes present which may cause special diseases, such as typhoid fever and scarlet fever, but also that many bacteria cause changes in the milk which make it injurious to health, particularly injurious to children. In this case the bacteria themselves may be of such a kind as not to produce disease if taken into the stomach alone, but they may nevertheless change the milk so as to make it to all intents a poison. The same thing is true to some extent with all food, particularly with food which is eaten raw, but it is specially the case with milk for the reason just given that the bacteria flourish in milk, and it has just been pointed out that impure

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water may be a source of contamination of milk; not the only source, it is true, but directly and indirectly it is perhaps the main source.

It is evident, therefore, that the public health may be endangered by unhygienic conditions on the farms and particularly by insanitary water supplies. The importance of water supplies for towns is very apparent as affecting the welfare of a large number of individuals in each case, but the supplies of farms, taken all together, are of scarcely less importance to the general health. The number of persons interested, even if the farmer and his immediate family alone were concerned, is in the aggregate very large, but, in view of the facts just stated, the interest of the whole population becomes evident, particularly as affecting the health of young children through contamination of the milk cans.

In this connection it may not be out of place to correct an erroneous idea which seems quite prevalent in regard to milk contamination through polluted water. The belief among farmers appears to be quite widespread that milk may become contaminated by the impure water drunk by the cows, the conception being that in some way bacteria pass from the stomach of the cow through the udder into the milk. There seems to be no good reason for believing that this takes place. It is true that milk becomes tainted by garlic and weeds which the cow eats, but this is a very different matter from the passage of bacteria from the cow's stomach into the milk. The danger from bacteria in milk arises mainly, if not wholly, from the use of unclean vessels and from slovenly methods of handling the milk after it has been drawn from cows. It is true, however, that if the cow is diseased, particularly if tuberculosis exists, or disease of the udder, bacteria may get into the milk from the cow. But bacteria from foul water do not pass directly from the stomach of the cow into the milk. It is nevertheless important for the health of cows that they have an abundance of pure water to drink.

REQUIREMENTS OF A SANITARY WATER SUPPLY.

The three factors necessary for a sanitary water supply are purity, abundance, and convenience. The most important of these factors and that which has received most consideration as a rule is purity. People naturally prefer clean, pure water, and they are generally educated up to the dangers arising from polluted water as a possible source of infection. Hygienic examinations of water supplies often begin and end with a determination of bacteriological or chemical contamination to the neglect of questions regarding proper location, abundance, and convenience—factors which can not be safely ignored. The water may be pure and sufficient for drinking purposes and yet

not sufficiently abundant for cleanliness. For sanitary purposes it is essential that the water should be in such quantity at all seasons of the year that there is no need for stinting in any direction. There should be an abundance for personal cleanliness, for the laundry, for washing the utensils of the kitchen or dairy, and for the premises generally. The importance of the unrestricted use of water is so great that some hygienists condemn the use of water meters in private houses in cities with a central water supply because many people are apt to stint themselves if the water is paid for according to the amount used.

Convenience is probably the least important factor, but it is nevertheless essential for a sanitary water supply. It seems from the result of the inspection of about 300 farms around Washington that this requirement is more often neglected than the matter of purity or of abundance. Most farmers take pride in what they regard as the purity and abundance of their water supply. Each one in the neighborhood will frequently boast of his spring or well in these respects, but many of them will year after year draw the water up in a bucket out of an open well, or pump it by hand into a pail, or bring it by hand uphill from the spring. Where such exertion as this is necessary in good and bad weather alike, persons will resort to economy in the use of water, at least for cleaning purposes.

No one rule for preserving health is more important than cleanliness, the frequent bath, clean clothing, clean vessels used for food—particularly receptacles for milk—and cleanliness of dwelling and stables. Nothing is so conducive to cleanliness as an abundant and convenient supply of clean water, and anything which facilitates the unrestricted use of pure water is in itself a hygienic measure.

SOURCES OF WATER SUPPLY.

Of the water which falls to the earth as rain, hail, or snow, a large part is evaporated from the surface of the earth and taken back into the air. Of the rest a part runs off to feed the brooks and rivers, and a part sinks into the soil to feed the springs and wells which are the source of domestic water supply for the farm. It percolates through the soil until it reaches the so-called "water table," which is a more or less porous layer of gravel or sand resting upon an impervious stratum of clay or rock. (See fig. 37.)

The water table follows the dip of the rock or clay layer, and is consequently to be found at various depths or may crop out at the surface, forming a spring. Where it is tapped by a shaft it furnishes the water for a well (fig. 37). When this water table lies between two impervious layers, if the point at which the well is sunk is at a lower level than some part of the water table, the water will

flow out and constitute an artesian well (fig. 37). A subartesian well is one in which the water comes up nearly to the top of the shaft.

SOURCES OF POLLUTION.

Water may take up something from most things with which it comes in contact. Some things like common salt and potash, as everyone knows, are readily dissolved in water, while many other substances are dissolved in very small traces. Not only solid substances but gases and liquids, as well as living micro-organisms—microscopic plants and animals—and minute particles of dust are all taken up by water. On its way through the air the water takes up various gases,

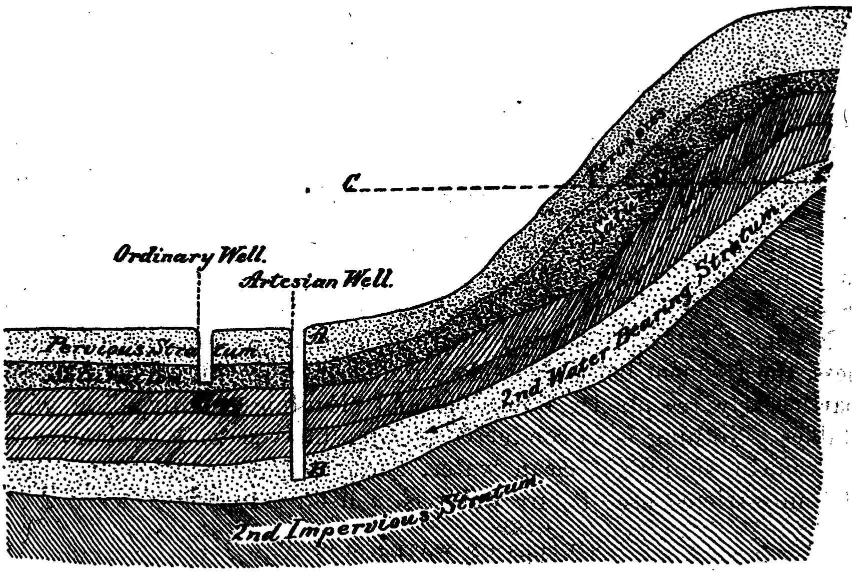

FIG. 37.—Geological formation showing manner in which water is secured from wells of varying depths. (From Harrington's "Practical Hygiene," 1901.)

such as oxygen, nitrogen, carbon dioxid, ammonia, etc., as well as fine dust particles and bacteria. On its passage through the soil it dissolves various minerals from the rocks, such as lime and magnesia, and if the soil is polluted in any way it takes up whatever it can dissolve of the pollution. In the upper layers of the soil the water also comes in contact with bacteria, which cause its contamination.

Many of the substances taken up by the water are harmless and some may be beneficial, others are undesirable, while still others may be harmful. The nitrogen and ammonia from the air are probably without significance from a sanitary point of view, though these may be of some value as sources of food for growing plants. The oxygen and carbon dioxid serve a useful purpose in giving life and sparkle

to the water, and in this way impart an agreeable taste. The bacteria which the water takes from the air are probably seldom of any significance, though it is true that occasionally bacteria of certain diseases have been found floating in the air, and these may be taken up by the water; still, this is probably not frequent, at least in rural districts.

The mineral matter, particularly the salts of lime and magnesia, make the water "hard" and, although this does not affect the health of those who consume the water unless the minerals be present in large amounts, it makes the water less suitable for purposes of cleanliness. The presence of sewage is of course an indication that the water may be injurious to health, for, as everyone knows, outbreaks of typhoid fever and of disorders of the bowels have been frequently traced to water that was polluted with sewage.

PURIFICATION OF WATER IN THE SOIL.

But while the water in its passage through the soil may become polluted with the substances just enumerated, on the other hand it undergoes a process of purification. The solid particles of dust and the bacteria taken up from the air are filtered out by the soil, particularly if the soil is sandy. It has been found that, at a comparatively short distance below the surface—4 or 5 feet—there are usually but few bacteria present in the ground, and the water which percolates through the soil, although it may become contaminated in the upper layers, is rid of bacteria on its passage farther downward. Deep-ground water usually contains few bacteria, but of course it may become contaminated when it is tapped for a well. If the layer of soil through which the water percolates on its way to the water table is saturated with filth some of the pollution may be carried down, particularly if the layer of soil is not deep.

PROTECTION FROM POLLUTION.

The water supplies of farms come from wells, springs, and cisterns. A recent inspection of the water supplies of some 300 dairy farms in Maryland and Virginia showed that wells are used much oftener on these farms than either of the other two, the proportions being about 5 wells to 3 springs and 1 cistern.

WELLS.

To guard against the pollution of wells the location is of importance. Where it is possible the ground should slope away naturally on all sides and the pump should be on top of a mound which should be well sodded or cemented all around. Sources of domestic

or of other pollution should be separated from the well by an impervious layer below ground to avoid the danger of pollution from seepage.

The ground immediately around the well should be protected from animals by a fence or otherwise. The shaft of the well should be thoroughly tight, and for this reason the use of terra-cotta tiles or metal pipe for the shaft is preferable to walling up with bricks and mortar. In any event the space immediately around the shaft proper should be puddled with clay or cement, or, as advised by Koch, have the upper part packed around with sand. The use of open wells, or even the use of chain pumps, is not to be recommended, since they are

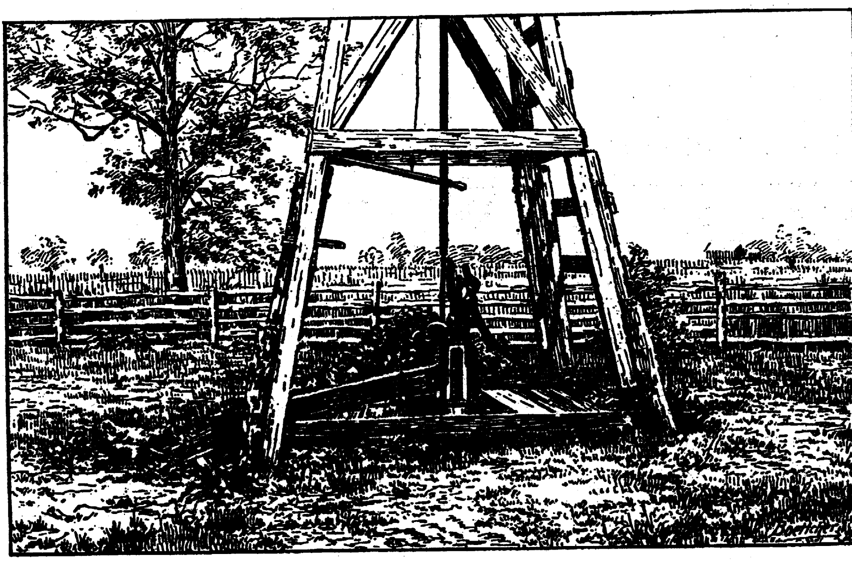

FIG. 38.—A well with good natural location, but with slovenly surroundings; not properly guarded against pollution.

more liable to pollution from the introduction of impurities down the shaft. In all cases the well should be guarded by a tight coping and cover. It is an advantage to cover over the well with a tight cover, and to place the pump to one side of the well shaft with an elbow connection.

A form of well known variously as the tube, or driven, or Norton, or Abyssinian well is good from a sanitary point of view. It consists merely of an iron pipe screwed together in sections driven down to the water-bearing layer. The lowest section of pipe is armed with a point and is perforated with a number of holes. In a well of this character there is no danger from seepage into the shaft and it is cheaply and quickly constructed. In case one such tube fails to furnish sufficient water others can be driven close by and all connected with one pump.

Every precaution should be taken to prevent the contents of a cesspool from soaking into the soil, for even if the cesspool is at a distance from the well the ground between may eventually become saturated and fail to act as a filter. As already stated, the presence of an impervious stratum between the well and the cesspool is a good protection, but where such a stratum does not exist the cesspool should be made watertight. The crude methods of sewage disposal still quite commonly in vogue in the country are a continual menace to the water supply.

Figure 38 illustrates a well which is imperfectly guarded against pollution and with very slovenly surroundings. The situation of the

FIG. 39.—A well with surroundings protecting it from pollution.

well in this case is good. It stands at a considerably higher level than the barnyard, which is below and at the left, and is separated from the well by a ledge of rock, while the domestic sources of pollution lie to the right and are several hundred feet away. The well is only about 7 feet deep, but it is bored into the solid rock, and in spite of its want of depth there would appear no good reason why it should not be made to fulfill the requirements of a sanitary supply, yet when it was inspected it was found to have a loose coping and there was no provision against pollution due to stray animals.

Figure 39 shows a well bored into solid rock, and although it is only 16 feet deep it would appear to be well protected from any source of contamination. Besides the protection afforded by the natural rock, the curb and cover are tight and, moreover, the cover has a slant so as to shed water.

An arrangement which seems to leave nothing to be desired is shown in figure 40. The well in this case is over 100 feet deep through rock; the barnyard lies off to the left and is at least 10 or 12 feet lower than the well. The dwelling is to the left and in front,

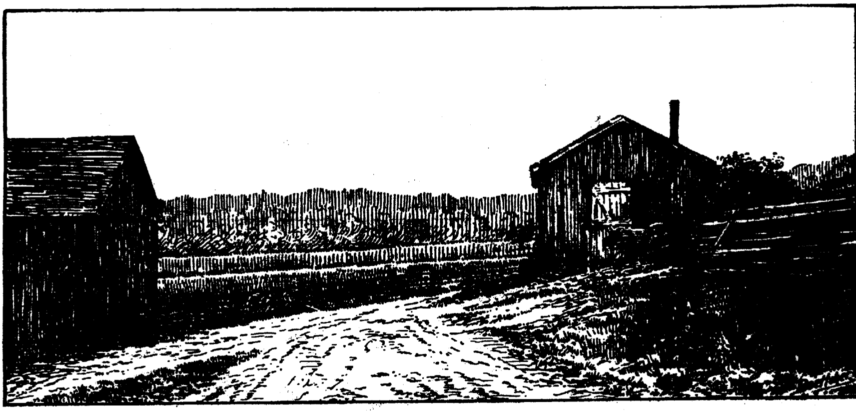

FIG. 40.—A well (in building at right) with excellent location.

and is still lower and farther away than the barn. The site of the well is near the top of the hill, inside the building seen at the right of the picture. The building shown is the dairy; the floor is cemented, and when it was visited it was found to be scrupulously clean.

SPRINGS.

What has been said of wells applies equally to springs, but, in addition to the danger of pollution from surface drainage and from seepage, if the spring is open it is liable to pollution by the introduction of impurities in dipping the water out. This source of contamination may be guarded against by inclosing the spring in a concrete casing on all sides and providing a tight cover and a pipe cemented in on one side to allow the water to run out. The cover should be removable, however, to permit of the cleaning out of the sand which always accumulates. Instead of the concrete casing a section of wide terra-cotta drain tiling has been used in some cases, and answers the purpose admirably if it is set in cement over the point where the water wells up out of the ground. The tiling should be provided with a tight-fitting cover and a pipe to allow the water to run off. Either of these two arrangements would obviate the danger of polluting the water by dipping unclean vessels into it. Some springs, although excellently protected by a coping on three sides and in other ways, are made liable to pollution by having steps leading down to the water's edge. Under such conditions the danger of introducing impurities from the soles of dirty shoes is of course apparent.

FIG. 1.—A SPRING WITH A GOOD LOCATION.

FIG. 2.—A SPRING WITH GOOD NATURAL LOCATION, BUT WITH INSANITARY SURROUNDINGS WHICH COULD EASILY BE REMEDIED.

Unless a spring has a tight coping on all sides and is provided with a tight cover and spout, so that the water does not have to be dipped up, it falls short of the requirements of a sanitary supply. Where it is possible the water from the spring should be conducted by pipe to the house, dairy, and barn.

In the inspection conducted by the Bureau of Animal Industry, already referred to, but few springs were found which were properly protected. Some of them had cement or tight stone coping on three sides with steps leading down on the fourth side. Some had a tight coping on all sides, but the coping was level with the ground and the water thus exposed to pollution. But in most cases the water ran out of fissures in the rock into a natural or artificial basin, or bubbled up from the bottom of such a basin. In such cases no special care was exercised to guard against pollution.

Plate XLVIII shows two springs surrounded on three sides and over the top by natural rock, but unprotected on the lower side in each case. The spring shown in figure 1 is remote from sources of domestic contamination, though it is in a pasture lot and is not fenced in. The dwelling is situated above and several hundred feet away up the hill shown to the right of the picture. The barn is still farther away in the same direction. The ground intervening between the house and the spring is in sod. The water is pumped up by a windmill to a tank near the house. The spring could be perfectly protected with little difficulty. In figure 2 the spring lies at the foot of the barnyard hill, and is shown in the picture to the left of the dairy house. Some protection from wandering stock is afforded by the railing seen in the picture. All the surroundings were untidy. There was filth up to the very edge of the spring. The fence seen to the left in the picture incloses the hog pen; and above, to the front and left, is the barnyard, though it is true the slope does not incline directly from the barnyard to the spring. This is naturally an excellent supply, and could be made to fulfill all sanitary requirements.

CISTERNS.

Where there is no spring and where for any reason it is not feasible to sink a well it becomes necessary to resort to cisterns, and if these are properly constructed and operated they may be made to fulfill all sanitary requirements. The walls should be water-tight, of course, both to prevent water from leaking out and to guard against pollution from without. The best cisterns are those constructed with two chambers separated by a porous brick partition through which the water is filtered. The water from the roof is made to run into one chamber, and is pumped out of the other after passing through the partition. The rain pipe from the roof should be provided with an arrangement for preventing the first water which falls in time of

rain from running into the cistern, since the first water after dry weather may become polluted with dust or bird droppings on the roof. The roof from which the water is caught should be preferably of slate. Water from wooden shingles is often tainted.

ABUNDANCE OF SUPPLY.

The average amount of water used in various cities in America and in Europe by each inhabitant per day varies greatly, being from 15 gallons in Vienna to 100 in Rome, 108 in New York, 120 in Detroit, and 122 in Chicago, Ill. But this amount includes the water used for all purposes—manufactories, street sprinkling, etc. A reasonable average amount for domestic purposes, as stated by Vernon Harcourt, is 25 gallons per day for each individual, and this is probably the amount which should be allowed on farms. Since the stock is usually watered at running streams this need not be taken into account in the reckoning. On farms generally, the supply is ample. It may occasionally run short in times of prolonged drought, but there was no evidence of scarcity on any of the farms recently visited by representatives of the Bureau of Animal Industry.

CONVENIENCE.

Comparatively few farmers seem to realize the importance of convenience in the matter of water supplies, even from a purely economic point of view, and much less from the bearing which such convenience has upon the cleanliness and consequently upon health. Less than one-fifth of the dairy farms recently inspected have windmills, rams, or other means of bringing the water into the house or dairy.

Year after year on many farms water is pumped by hand or brought up the hill from the spring in buckets at the expenditure of a great amount of labor in the aggregate. Where it is at all feasible the water should be pumped into a tank and conducted at least into the dairy and the kitchen by pipe. Even where the water has to be pumped by hand it is desirable to have a tank, for this insures abundance for purposes of cleanliness. But of course, if feasible, resort should be had to some mechanical device—a windmill, engine, or ram—for forcing water up to a tank to furnish a convenient supply for the house, barn, and dairy, in each of which there should be at least one spigot.

In conclusion it may be said that it is not usually a difficult matter to comply with all the requirements of a sanitary water supply on the farm. It requires only ordinary intelligence in selection of the site and subsequent management, besides a certain expenditure of time and money necessary for the construction of devices for protection and convenience. Each supply presents its own problems, which must be solved with proper recognition of the objects aimed at, and these are purity, abundance, and convenience.

THE USE OF SMALL WATER SUPPLIES FOR IRRIGATION.

By SAMUEL FORTIER,

Chief of Irrigation Investigations, Office of Experiment Stations.

THE SOURCES OF SMALL WATER SUPPLIES.

A spring may be made to yield a large revenue to the western farmer or stockman if the flow is stored in an earthen reservoir. When the discharge from a spring is small, it is a waste of time and water to apply it directly to the soil; but when it is allowed to accumulate for a week or more in a reservoir, there may be sufficient water to irrigate one or two acres in a short time. Small storage reservoirs may likewise be used to good advantage to impound the storm waters of small creeks or torrential streams which flow for brief periods and have dry channels the remainder of the year. In parts of the West where water is scarce and valuable, small supplies have been obtained from the beds of dry streams, ravines, or other depressions by means of submerged dams and tunnels. Artesian wells provide still another source for small supplies for either irrigation or domestic purposes. Not infrequently it happens that considerable volumes of water flow in steep channels which are from 25 to 100 feet or more below the level of irrigable land. Under such conditions a modern form of the hydraulic ram may be profitably used.

Ordinary wells, however, whether dug or bored, are the most common source. Water collects in these and is raised to the elevation desired by means of windmills, animal power, engines of various kinds, or electric motors. Sometimes the water in streams, lakes, canals, and reservoirs is below the level of fertile tracts of land which it is desirable to irrigate, and the same means is used to raise it to the required height.

THE NEED OF SMALL WATER SUPPLIES IN THE ARID REGION.

From an agricultural standpoint the greatest need of the arid and semiarid regions is a larger water supply. Out of a total of about 900,000,000[a] acres, less than $1\frac{1}{8}$ per cent is artificially watered. When all of the available water supplies are utilized it is doubtful if more than 7 or 8 per cent of the total area can be irrigated. The total

[a] Irrigation in the United States, by F. H. Newell, p. 28.

extent of land which can be irrigated forms but a small part of the fertile western lands which might be made highly productive and valuable if the rainfall were supplemented by irrigation. Montana may serve as an example. Compared with other arid States, it is well watered, yet when all the available supplies from streams, lakes, reservoirs and other sources are utilized, at least 93 per cent of its total land surface will be beyond the reach of the irrigation ditches.[a] The area irrigated at present is a trifle more than $1\frac{1}{2}$ per cent, yet it is from this comparatively small area that the greater part of the agricultural wealth of the State, exclusive of stock grazing, is derived, and from which a large part of the total revenues is raised. In 1902 unfenced grazing lands were assessed at 75 cents per acre, while first-class grain and forage lands under irrigation were assessed in many cases as high as $30 per acre. A few acres of irrigated land frequently yield more profits than can be obtained from a section of grazing land.

The need of irrigation is perhaps felt more keenly by the man who establishes a home on the dry uplands and makes a living by raising grain and pasturing a small herd of stock. The rainfall is not sufficient to grow shade trees, fruit trees, vegetables, or forage crops. As a result, his home is dreary and unattractive; and canned goods, bought at high prices, must take the place of fresh vegetables grown on the farm. The small water supply when properly utilized is a great boon to such a home.

A point worth mentioning in favor of the small, as compared with the large, supply for irrigation is the fact that the former is more economically used. It is well known that when water is both cheap and abundant large quantities are wasted, to the detriment of the land and the lessening of profits. Small supplies cost much more per unit of flow, but under careful cultivation and irrigation yield larger returns in proportion to the water used.

This is brought out clearly in the following descriptions of typical small supplies for the arid region. In the case of a spring which was stored in Montana, the flow was only 1 miner's inch, which represents the amount of water which will flow through an opening 1 inch square under a head of 4 inches. This small flow produced in one season products to the value of $472. The discharge from a windmill of somewhat less than 1 miner's inch capacity irrigated successfully 2 acres, which yielded vegetables and fruits to the value of $165, while in the more favored locality of southern California the use of $1\frac{3}{8}$ miner's inches per season produced oranges to the value of over $3,000, which netted the owner $1,650.

[a] Irrigation in Montana, U. S. Dept. Agr., Office of Experiment Stations Bul. 172.

STORING THE FLOW FROM SPRINGS.

Several years ago the writer made use of a spring on a farm in the Gallatin Valley, Montana, by storing the flow in a small reservoir. The spring rose in the upper part of the farm, and, as a result of cultivation below, its natural channel became filled in, and the water spread over several acres, creating an unsightly bog. To remedy this condition and to procure water for the irrigation of a garden and orchard near by, the earth and mud just below the spring were removed and formed into an embankment. The reservoir site was naturally a poor one, but no other location would have been high enough to water the garden and orchard.

The outline of the reservoir when full was irregular, but corresponded in area to a basin 100 feet long by 55 feet wide and 4 feet deep, holding one-half of an acre-foot of water, or 162,925 gallons. The discharge of the spring in summer was about 9 gallons per minute, or 1 miner's inch, and on account of the loss due to seepage and evaporation it took fifteen days to fill the reservoir.

In building the reservoir the channel was first cleaned out down to solid material, and in this trench was laid a 6-inch sewer pipe, which connected at the lower end with an irrigating ditch and at the reservoir end terminated in a vertical box. The box had a double set of flashboards, to hold the water at any height desired. The sewer-pipe joints were filled with cement mortar, and cement concrete was used to make a tight connection between the pipe and the box and also for a cut-off wall around the upper end of the outlet pipe.

In building the embankment the earth was sufficiently moist to pack well under the horses' feet, and no sprinkling was necessary. Figure 41 shows the outline of the reservoir and the crops irrigated. The chief items of cost were as follows:

Cost of reservoir for storing water from spring.

Excavation, 500 cubic yards, at 10 cents	$50
Sewer pipe, 200 feet 6-inch pipe, at 16 cents	32
Concrete, ½ cubic yard, at $8	4
Wooden box and footbridge	6
Labor and incidentals	20
Total	112

The stored water was conducted in an earthen ditch to a 2-acre tract containing red clover, orchard trees, and small fruits. One-half of an acre was planted to red clover; a tract of the same size was planted to Yellow Transparent, Duchess, and Wealthy apple trees and Transcendent crab trees. One-third of an acre was in Wilson Improved strawberries, one-third of an acre in Marlboro raspberries, and the remainder was planted to dewberries, Fay Prolific currants, and Downey gooseberries.

With the exception of the clover, the entire tract was irrigated in furrows from two to four times during the growing season. The clover was flooded three times from small field laterals, spaced 50 feet apart.

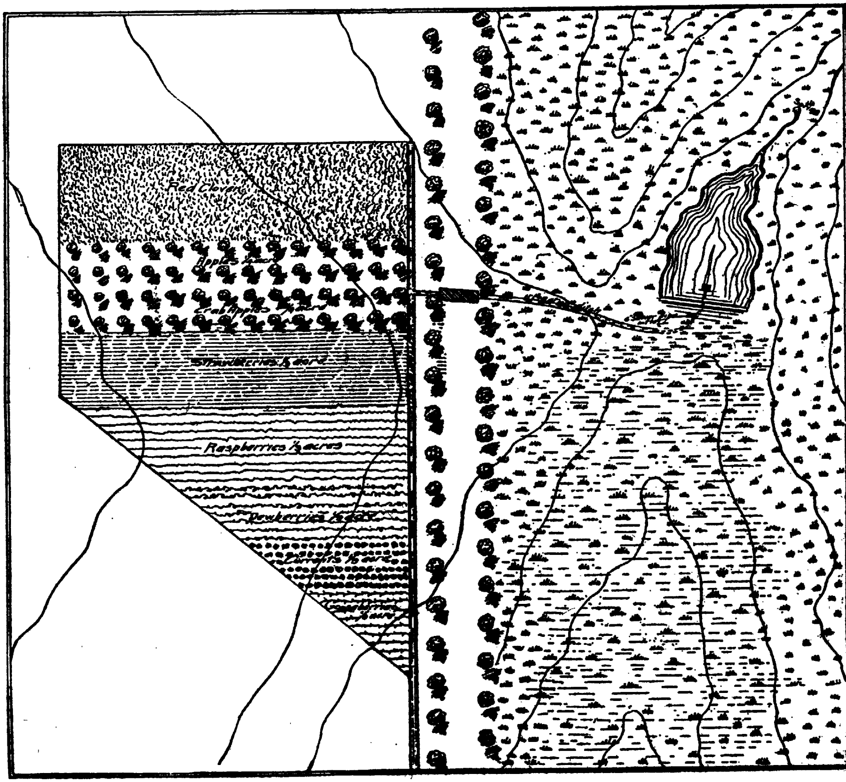

FIG. 41.—Two-acre tract irrigated from reservoir fed by spring.

The returns for the season at the end of the third year from planting were as follows:

Returns from use of stored spring water in irrigation at end of third year.

Red clover, 2¾ tons, from 3 cuttings, at $6	$16.50
Apples, beginning to bear	0.00
Crab apples, beginning to bear	0.00
Strawberries, 2,500 quarts, at 7 cents	175.00
Raspberries, 1,500 quarts, at 10 cents	150.00
Dewberries, 1,000 quarts, at 10 cents	100.00
Gooseberries, 200 quarts, at 5 cents	10.00
Currants, 300 quarts, at 7 cents	21.00
Shade and ornamental trees	0.00
Total	472.50

If these 2 acres had not been irrigated they would have produced under dry-farming methods at the rate of about 30 bushels of wheat per acre every other year. The annual revenue from the 2 acres when wheat is worth a cent a pound in Montana would thus be $18.

The foregoing illustrates how a small spring may be utilized to good advantage by the farmer of ordinary intelligence. With the exception of the piping, a few sacks of Portland cement, and a small amount of lumber, there is no outlay necessary for material and all the work can be done by the farmer or his hired help. The crops that can be grown and the resulting profits should be an inducement to make use of small storage reservoirs. In a country with a topography as varied as that of the Rocky Mountain States springs are numerous and there is abundant opportunity to utilize them in some such way as has been pointed out. Sometimes the spring or small creek is large enough to irrigate a small ranch. Even then a reservoir is needed to hold the night flow and to create a head large enough to spread rapidly over the surface of the fields. Larger reservoirs which serve a number of farms cost much less in proportion to the area served. Coöperative reservoirs of this kind are quite common in a few districts of the arid region, particularly in northern Colorado. In 1906 in Irrigation Division No. 1, according to the State engineer of Colorado, there were stored 372,408 acre-feet. Rights in storage reservoirs which are certain to be filled each year readily sell for $20 to $40 per acre-foot.

SMALL WATER SUPPLIES FROM WINDMILLS.

Early in the year 1907, seven windmills of different makes and sizes were installed at the demonstration farm near Cheyenne, Wyo. This farm is one of several recently established by the Irrigation Investigations of the Office of Experiment Stations in the plains country lying east of the Rockies for the purpose of showing how small water supplies may be best utilized and some of the advantages arising from the irrigation of limited areas in districts which produce meager crops of winter wheat and native grasses. F. W. Roeding, in charge of the central district, has had general supervision of the farms, and P. E. Fuller, civil engineer, has installed and operated the windmills.

In keeping records of the operation of the most common types of windmills Mr. Fuller has reached the conclusion that they are overrated by the manufacturers. The work which it is claimed a mill is able to perform is frequently computed from the average wind velocity of the locality. This would be fair only if equable winds prevailed. In velocities less than 5 miles per hour very little of the useful energy is available in pumping, and similarly in wind velocities exceeding 30 miles per hour the ordinary mill is out of commission.

The useful work done by a 12-foot mill in raising water against a total head of 56 feet is given in the following table:

Work done by windmills under varied wind velocities.

Velocity of wind in miles per hour.	Discharge in cubic feet per hour.	Discharge in gallons per hour.
6	12	89.76
8	36	269.28
10	67	501.16
12	96	718.08
17	170	1,271.60
18	181	1,353.88

The following table gives the number of gallons pumped through a vertical lift of 56 feet by each of four mills when the average wind movement was 13 miles (12.98) per hour. If the head is reduced, the amount of water pumped may be increased in about the same ratio:

Work done by windmills of different sizes.

Mill.	Time.	Number of gallons pumped.
	Days.	*Gallons.*
16-foot direct stroke	45½	752,967
14-foot back-geared	45½	666,991
13-foot back-geared	45½	502,207
12-foot back-geared	45½	408,854

Windmills may be used to pump water from canals, ditches, reservoirs, lakes, and wells. In irrigated districts it is desirable to locate the farm buildings on high ground, and the site selected is frequently above the canal. A windmill furnishes one of the most convenient and best means of elevating sufficient canal water to supply all domestic needs, as well as water for the irrigation of a garden, family orchard, and shade trees. Water pumped for domestic purposes should be first stored in a tank, and then filtered, but water used in irrigation may be applied directly from the pump, tank, or reservoir. The pipe which conducts the water from the pump to the tank or reservoir should be of ample size, in order to lessen the loss of head created by friction. The speed of the water as it passes through the discharge pipe should not exceed 2 feet per second, or about the same rate as the water in a canal.

A word of warning is necessary in regard to securing water from drilled wells. One should be certain that the well will furnish the required amount of water before placing an order for the windmill and other equipment. The capacity of the well should be at least 50 gallons per hour, and 75 to 100 gallons would be safer. Then, too, in the territory just east of the Rocky Mountains steps should be taken

to test the quality as well as the quantity of water. Alkali salts are often present in sufficient quantities to render the use of water harmful to plant life.

Owing to their irregularity of action, irrigation from windmills is not practicable unless the water pumped is stored in a reservoir or some form of tank. If a reservoir is used, the losses due to absorption or percolation should be made as small as possible. The small reservoirs which serve to store water for the irrigation of orchards in southern California are lined with cement concrete, cement plaster, or a wall of field stones rendered water-tight by cement mortar (fig. 42). Of late a heavy grade of crude oil containing a large percentage of asphalt has been successfully used on the walls of reservoirs. In the cheaper forms of reservoirs in the Rocky Mountains districts clay puddle mixed with straw makes a fairly good lining.

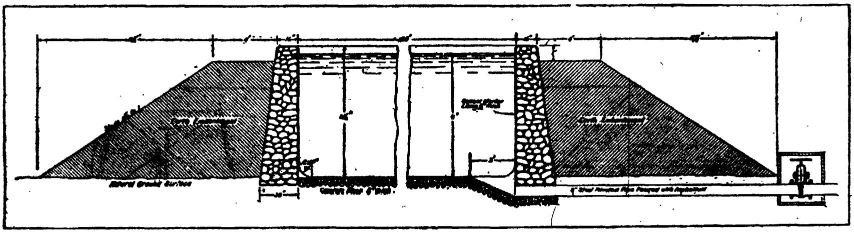

FIG. 42.—Cross section of reservoir built of field stones.

The factory cost of a good serviceable windmill varies from \$150 to \$200. This includes the steel tower, 40 feet high, and the pump. The freight charges on a mill of this kind for hauls less than a thousand miles will be about \$35. The cost of assembling and erecting should not exceed \$10, making the total cost of the mill and pump erected approximately \$225. The items of initial cost, as well as the expense for repairs and maintenance per annum, are given in the following estimates:

Original cost and annual expense for maintenance and repairs of windmill irrigation plant.

A 14-foot windmill erected	\$225.00
Dug well, 6 by 6 feet, 20 feet deep, with curbing	60.00
A 4-inch pipe line, 100 feet long	35.00
Reservoir, 100 by 200 feet, 4 feet deep	250.00
6-inch slip-joint irrigation piping and header, 300 feet, at 30 cents	90.00
Total initial cost	660.00
Repairs and maintenance per annum:	
Interest on mill at 6 per cent	13.50
Depreciation on mill at 8 per cent	18.00
Interest on well at 6 per cent	3.60

Repairs and maintenance per annum—Continued.	
Depreciation on well at 4 per cent	$2.40
Interest on pipe line at 6 per cent	2.10
Depreciation on pipe lines at 8 per cent	10.00
Interest on cost of reservoir at 6 per cent	15.00
Depreciation on reservoir at 2 per cent	5.00
Oil for mill	3.00
Labor on mill, 6 days annually, at $2	12.00
Renewals for pump and mill	5.00
Total operating cost of plant per annum	89.60

The number of acres which a mill of this kind can furnish water for depends mainly on the lift or head and wind movement, but also on the manner of conveying, storing, and applying the water, and to a less degree, perhaps, on a large number of crop, soil, and climatic conditions. As previously stated, a 12-foot mill at Cheyenne, Wyo., discharged 67 cubic feet, or 501 gallons, per hour in an average wind movement of 10 miles an hour through a total head of 56 feet. Operating during the months of May, June, July, and August it would deliver at this rate 4.5 acre-feet, or sufficient to irrigate 3 acres, if there was no loss. If the height to which the water is lifted is cut in two, the discharge would be doubled, as well as the area irrigated. Taking, however, the higher lift and 4.5 acre-feet as the total discharge during the crop-growing season in the higher altitudes, the acreage irrigated would not much exceed 2 acres, if the ordinary reduction is made for seepage, evaporation, and other losses of water.

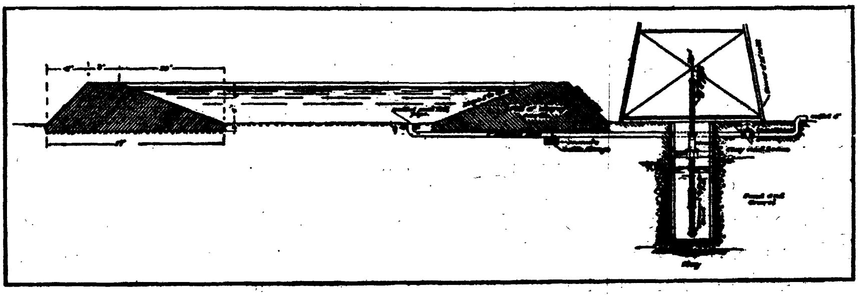

FIG. 43.—Detail of reservoir, well, and piping—an ideal arrangement.

The writer is indebted to Messrs. Roeding and Fuller for what they consider an ideal arrangement for a windmill, reservoir, and small irrigated tract containing 2 acres. The accompanying illustrations (figs. 43 and 44) show all three. In planning this arrangement due consideration has been given to the needs of stockmen and dry-land farmers in that extensive belt of country which slopes eastward from the Rocky Mountains and extends from Canada on the north to the Gulf of Mexico on the south.

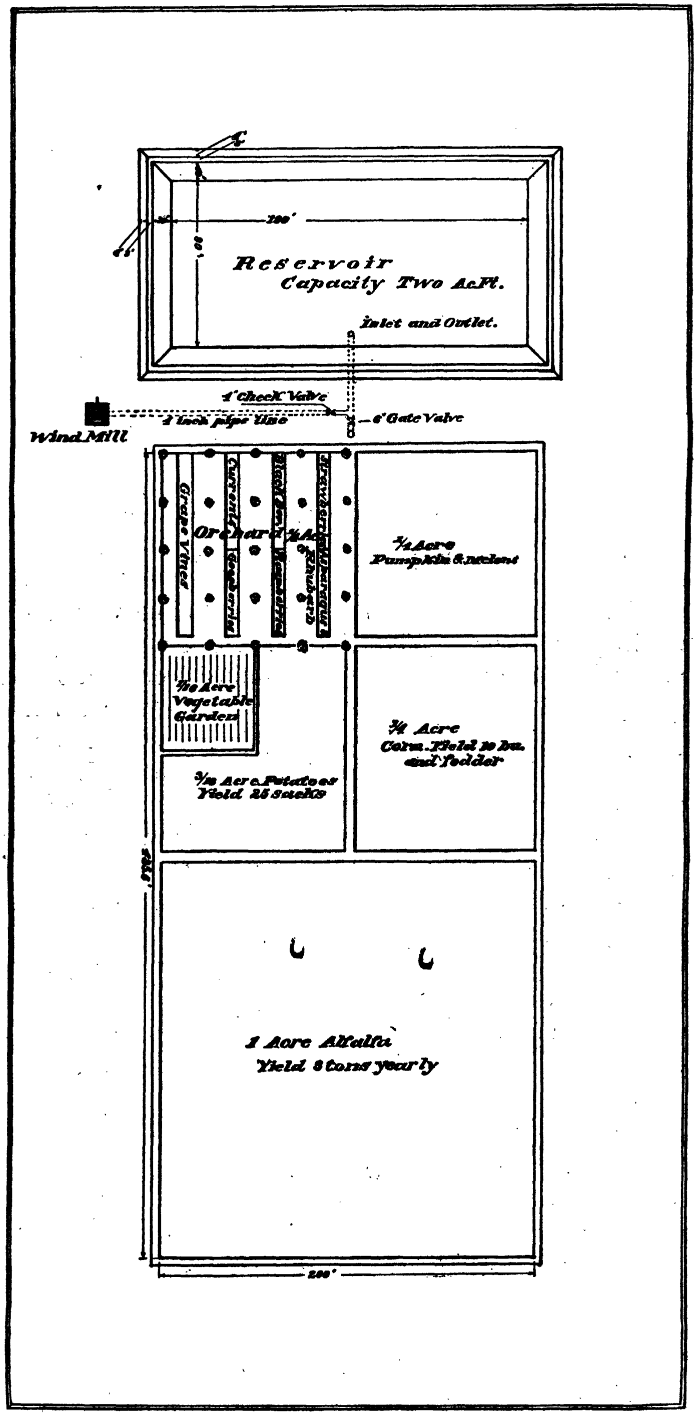

FIG. 44.—An ideal arrangement for windmill irrigation.

A conservative estimate of the value of such products as can be grown on this ideal tract and of the crops most needed by the settlers of that region is here given:

Estimate of crops grown on ideal windmill irrigation tract, with their values.

Alfalfa, 1 acre, 3 tons, at $10	$30
Potatoes, $\frac{3}{16}$ acre, 25 sacks, at $1	25
Corn, $\frac{1}{4}$ acre, 10 bushels and fodder	10
Pumpkins and melons, $\frac{1}{4}$ acre	20
Vegetables, $\frac{1}{16}$ acre	30
Fruit and berries, $\frac{1}{4}$ acre	50
Total	165

In addition to the crops, shade trees are grown on this tract.

DEEP-WELL PUMPING PLANT.

In southern California, as a rule, the foothill lands where water is available are very desirable for the planting of citrus fruit trees on account of their fertility and protection from frost. Water companies build their canals as high above the surrounding country as economy will permit, but a high-line canal can not always be built to cover all valuable foothill slopes. Pumping from wells must then be resorted to; and if water can be obtained within reasonable depth, pumping plants can be operated with attractive profits.

The soil found along the foothill slopes is quite rich, but nearly always very porous, on account of the large percentage of gravel and small bowlders, and this necessitates the use of an unusually large flow of water for irrigation. Considering this fact and also that the average holding of a citrus fruit grower rarely exceeds 10 acres, it would hardly be true economy for the individual grower to provide a pumping plant of such capacity as would supply a stream of water of 60 miner's inches for, say, 24 hours each 30 days. He must either put in a smaller pumping plant with a storage reservoir, secure water from a community plant irrigating 75 or 100 acres, or buy water from a company's plant operated for profit. Out of 41 deep-well pumping plants in operation near Pomona, in southern California, 2 have a discharge of more than 30 miner's inches.[a] The head generally used in the foothill district near Pomona is 60 miner's inches, and in order to use a head of this size the smaller streams must be stored in reservoirs, where the water can be drawn upon at will and in such volume as desired.

As a concrete example we will take a 10-acre orange orchard and irrigation system located on the foothill lands near Pomona. Deducting

[a] Mechanical Tests of Pumping Plants in California, U. S. Dept. of Agr., Office of Experiment Stations Bul. 181.

the area of land covered by a reservoir and buildings, the owner of this orchard irrigates and cultivates about 9.35 acres of oranges. He buys the water at 3 cents per miner's inch per hour from a pumping plant near by that supplies a stream of 30 miner's inches to his storage reservoir until it is filled. He empties this reservoir in half the time required to fill it, using a 60-inch head with greater economy on his open gravelly soil than he could a 30-inch head. He uses the water when the trees most need it, and irrigates only in the daytime, thereby saving night labor. His reservoir cost $2,500, and being built of concrete masonry there are practically no charges for maintenance. His only expense, then, is the interest upon his money invested in the land and in the improvements thereon. This is partially covered by rental of $75 per year for use of reservoir by an orchardist below, who stores his water in the same reservoir when it is not in use by the owner.

The pumping plant supplying this tract represents an investment of about $4,500 and furnishes water for about 70 acres of citrus fruit. The well is 14 inches in diameter and 420 feet deep. The water is within 125 feet of the surface and is raised with a double-acting plunger pump having a cylinder 9 inches in diameter and a stroke of 36 inches. It makes 17 strokes per minute and discharges 275 gallons per minute, or about 30 miner's inches. The pump is belt driven with a 30-horsepower gasoline engine. The cost of operating several of these deep-well pumping plants is itemized in a recent bulletin of the Office of Experiment Stations.[a]

The reservoir shown in the accompanying illustration (fig. 42) was built of cobblestones, varying in size from 5 to 15 inches in diameter, picked up and hauled from the orchard. This sort of construction for a small reservoir seems to be the most economical under the existing conditions. The porosity of the soil requires that the reservoir be lined, and the most satisfactory lining thus far has been concrete covered with an impervious trowel coat of cement plaster. In order to use the water upon all the land the bottom of the reservoir must necessarily be above or at the original ground surface. This means that the reservoir, with the exception of the bottom, will be built above the ground surface, which is an unsatisfactory method for any but this type of reservoir. Then, again, the inside walls being perpendicular, the reservoir occupies less area than one with sloping banks of the same capacity. The reservoir with sloping banks lined with a thin layer of concrete would be slightly cheaper to build, but the income from the extra citrus trees that could be planted on the ground not used would offset the difference in interest on first cost. The reservoir is 120 feet in diameter, 8½ feet deep, and holds 8 feet of

[a] U. S. Dept. of Agr., Office of Experiment Stations Bul. 181.

water. Its capacity is 678,500 gallons, or enough to cover 9.35 acres 2⅝ inches deep at each irrigation, which is a generous irrigation for that locality. Seven such irrigations will be applied between April 1 and December 1 of each year. General reports on the Pomona district show that about 1.2 feet of water are applied in six to eight irrigations during the season, which would be an average of 2 inches for each irrigation.

The water is drawn from the reservoir through an 8-inch gate valve and flows through an underground cement pipe 8 inches in diameter to cement standpipes along the higher side of the orchard. One of these standpipes is located at the upper end of each row of trees, and from small openings the water flows into the several furrows between the rows of trees.

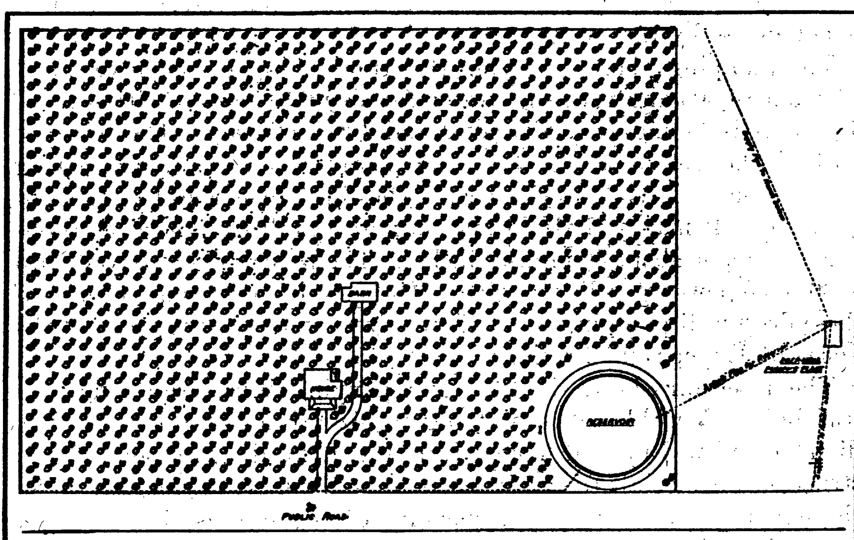

FIG. 45.—Sketch showing use of small water supply in the irrigation of 10 acres of citrus fruit.

Without a water supply for irrigation the chances are that in some years rainfall will be ample during the early part of the growing season to produce a crop of grain on the foothill slopes. A crop will likely be grown often enough to pay for the seed and labor of planting during the past profitless seasons, but the net income is so small that we might almost consider these lands worthless, with the exception of a chimerical value, probably due to location and climate. With a possibility of a water supply these lands rise in value from nothing to $200 per acre for the bare land. This orchard of 8-year-old orange trees, shown in the accompanying illustration (fig. 45), is worth on the market at present about $1,200 per acre. The following

will show the difference in profits on an 8-year-old orange orchard of 9.35 acres, due principally to the application of water:

Receipts and expenses of irrigated 10-acre orange farm.

RECEIPTS.		
Packed oranges, 240 boxes per acre, or 2,244 boxes in all, at \$1.32 per box delivered at packing house	\$2,962.00	
Rental of reservoir	75.00	
		\$3,037.00
EXPENSES.		
Water, at 3 cents per hour per inch, 1½ feet over surface for the season	252.90	
Irrigation and cultivation, at \$20 per acre	187.00	
Fertilizer, at \$35 per acre	327.25	
Pruning, at \$6 per acre	56.10	
Packing and hauling, at 7 cents per packed box	157.08	
Interest on \$2,500 reservoir, at 6 per cent	150.00	
Interest on 10 acres at \$400, at 6 per cent	240.00	
Interest on distributing system, \$220 at 6 per cent	13.20	
		1,383.53
Net profit		1,653.47

In the above estimate of expense we have considered the value of the orchard as \$1,200 per acre, but during the past seven years it has paid enough to cover expenses and pay two-thirds of its present value, leaving only \$400 per acre outstanding. Now, assuming the orchard to be worth \$1,200 per acre and improvements \$2,720, we find that under the above conditions the net profits for the year would be 11.2 per cent on the present value of the orchard.

SMALL ELECTRIC PUMPING PLANTS.

Where electricity is available for power purposes, there are several advantages to be derived from its use in small pumping plants. A pumping plant electrically driven can be operated upon a moment's notice and may be used continuously or intermittently, as desired. With gasoline or steam engines considerable attendance is required, while an electric motor needs only to be examined perhaps once every twenty-four hours. Should any accident occur to either pump or motor while running, the power will be cut off automatically, without any of the machinery becoming damaged. Largely owing to this fact, the cost of repairs for an electric pumping plant is far less than with other forms of power. Another fact of considerable importance in judging the value of a pumping plant is that an electric motor is reliable and ready for operation at all times.

In figuring the serviceability and cost of an electric pumping plant let it be assumed that water for irrigation is to be supplied at

the rate of 275 gallons per minute from a well 20 feet deep. This is the average economical capacity for a No. 3 centrifugal pump, and the work requires about 0.2 horsepower for each foot in height to which the water has to be raised, or 4 horsepower for the total lift. In twenty-four hours this pump will furnish water to cover about 1¼ acres to a depth of 1 foot, or 4 acres can be given a 4-inch irrigation in twenty-four hours. Running continuously, this plant will furnish 50 acre-feet of water per month. Since the additional cost is very little, it is good economy to provide a large factor of safety by using a 5-horsepower motor. Should the lift be increased by lowering the surface of the water in the well, there would still be power capacity to do the work without danger to the machinery.

Since it is often inconvenient to irrigate at night, the pump could be operated but twelve hours each day, unless some means were provided for the storage of the water pumped at night. This will amount to about 30,000 cubic feet of water, and would require a reservoir 90 feet square, with an average depth of about 4 feet of water. The water stored during the night would enable the irrigator to run a much larger head than would be possible with direct discharge of the pump. Ravines or hillsides often provide excellent natural reservoir facilities, but even on level ground such a reservoir could be constructed at a small cost.

The horizontal centrifugal pump should be placed directly over the well and the electric motor might be directly connected with the pump, care being exercised to keep the suction lift of the pump as low as possible. The direct connecting of the motor to the pump has the double advantage of doing away with the troublesome and expensive belt drive and lessening the size of house necessary for protection from the weather. A house 6 feet square provides ample room for the machinery where it is possible to have the pump and motor at the surface. During the summer months trouble is often occasioned by electric motors heating when placed in a small wooden building, poorly ventilated, but this objection can be remedied by making the lower 3 feet of two sides of the building into sections and hinging them at the top. By lifting the doors from the bottom the sun will be excluded from the machinery during the heat of the day and at the same time a current of air will pass through the house. To prevent dogs or chickens entering the house, wire netting should be placed over the openings. These features are shown in figure 46.

The average cost for electrical power is about $50 per horsepower per annum, which is for continuous operation of the plant. Charges are usually so regulated that power taken for short periods costs much more in proportion than if taken at a yearly rate. Expense for maintenance will be very slight and repairs will be required principally on account of breakages due to wear, which will be covered by depreciation charges.

Assuming an average irrigation season of five months, the pump will furnish 250 acre-feet of water, with a loss of 30 per cent; this would leave 175 acre-feet for irrigation. Taking the quantity of water necessary to bring crops to maturity as an average of 2 feet,

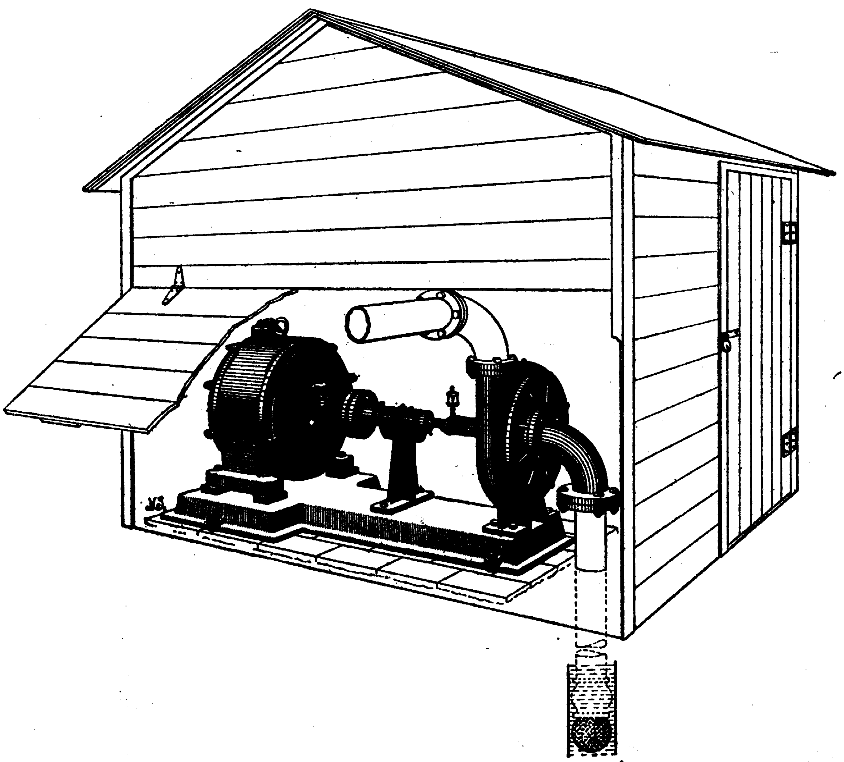

FIG. 46.—Centrifugal pump direct-connected to electric motor.

there would be ample water supplied by this pump to irrigate an 80-acre ranch. With an annual operating expense of $296.15, the cost of irrigation per acre per season would be $3.70, or about $1.85 per acre-foot of water.

Original cost and annual expense for maintenance and repairs of irrigation pumping plant operated by electric motor.

Original investment:	
Materials for pump house	$25.00
Pump, No. 3 centrifugal, complete, with suction pipe, valve, etc	95.00
Motor, 5 horsepower	82.50
Transformers, 3, at $38 each	114.00
Cost of wiring, installing motor, and hanging transformers	25.00
Cost of 10-inch well, 45 feet deep, cased	75.00
Total	416.50

Maintenance and repairs per annum:

Cost of power, at $50 per horsepower per year	$200.00
Interest on plant at 6 per cent	25.00
Depreciation on investment at 13 per cent	54.15
Labor on plant per annum, 6 days at $2	12.00
Oil for motor and pump	5.00
Total operating cost per annum	296.15

In many instances where crops can be grown with greater or less regularity and success without irrigation, the watering of a small area insuring a food supply for the farmer's family and his domestic animals will mean success where otherwise there might be failure, but in every case it will mean a true home, with fruit, fresh vegetables, shade, and flowers. In other words, on the use of all available water supplies depends the future of the semiarid region—whether it will be a region of large holdings farmed chiefly by nonresidents who will spend only so much of their time and money in the country as they are compelled to do, or a section of homes with schools, churches, and all that goes to make up our best rural communities.

TRUCK FARMING IN THE ATLANTIC COAST STATES.

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INTRODUCTION.

The development and extension of truck farming in the Atlantic coast States has been coincident with the development of transportation facilities throughout that section. In the beginning the points affording water connection with the great consuming centers of the North were those at which truck farming first became established. Later the railways became feeders to the steamship lines, and following this came the development of express shipment, which has been almost entirely supplanted by fast freight and refrigeration in the handling of extensive truck shipments from distant fields of production.

The phenomenal growth of the great consuming centers of the country has stimulated a corresponding growth and extension of the food-producing territory, especially that capable of producing perishable truck crops. The demands for vegetables out of season, followed later by the continuous demand for fresh vegetables throughout the year by the great cities, led first to the market gardeners located near the cities supplementing their field operations by extensive forcing-house enterprises. Naturally, the products from the greenhouses were expensive and available only to the few who were able to pay fancy prices for green products out of season. The improvement and extension of the transportation facilities which came with the great railway-building era of the United States made it possible to take advantage of the wide diversity of climate offered along the Atlantic coast of the United States to furnish these perishable products to the great cities of the North and East.

Transportation facilities, together with cheap labor and cheap lands at the South, have made it possible to produce in extreme southern locations products out of season at the North in competition with greenhouse products. The greater land area and the smaller amount of capital involved in the production of crops at the South, even though transportation charges were high, have enabled southern growers to produce much larger quantities of the desired crops than could be grown profitably under glass. It was therefore not many years before lettuce, celery, tomatoes, radishes, beets, and bunch beans came to be regular winter and early spring products of gardens located at great distances from the centers of consumption.

The first development of truck farming, as we now recognize it, as distinguished from market gardening, took place about Norfolk, Va., and Charleston, S. C. Both of these places were provided with steamship connections to northern ports before rapid railway transportation became a feature in the moving of perishable products, and as a result of these advantages for reaching the markets these two ports became important truck-producing centers for supplying the northern trade.

Besides these advantages, the peculiar geographic formation of the territory immediately surrounding Norfolk gives it a winter climate characteristic of sections many miles southward. The fact that the coast line of the United States at this particular point is very broken, together with the proximity of the Gulf Stream, gives this area a winter climate which enables it to produce some of the standard garden crops without protection and many of the more tender crops with only slight protection during the winter months. The islands off the coast of South Carolina, in the vicinity of Charleston, are so protected by the warm currents and by the atmosphere of the sea that orange trees are grown successfully in the open, and in some favorable seasons are known to produce fruit. It is therefore possible to grow the hardier truck crops in the open and the more tender ones with very slight protection during the winter.

The advantages of the Norfolk region for truck work appealed to a Jerseyman by the name of Hugh Bates, who went to this section about 1840. Naturally he followed the practices of his home people of New Jersey in the new territory, and, while he found some of his precautions unnecessary, his work on the whole was successful. He was followed later by other growers from the same territory, and in 1854 the steamer *Roanoke* carried the first 200-barrel shipment of garden truck from Norfolk to New York.

Thirty-six hours were required to make the voyage, and difficulty was experienced in keeping these perishable products from heating during this period. Four hundred packages was the capacity limit of the boats in use at that date, while at the present time the increased tonnage of vessels in this service enables them to carry as high as 25,000 packages on a single trip, which can be made in eighteen to twenty hours.

It was not until thirty years later that the first all-rail shipments of truck were made from this territory. Railways began carrying the products from Norfolk to northern markets in 1885, and from Charleston in 1888. About the same time Florida sent her first carload of oranges to the New York market, and in 1889 was shipped her first carload of strawberries under refrigeration. With the adaptation of refrigeration to car and steamship service and the lessened time required to transport perishable commodities, the territory trib-

utary to the great markets of the North has been wonderfully increased, and the doors of the market, as it were, now open direct into the gardens of the South. From the small beginnings just indicated, the industry has grown until the products are measured in thousands of carloads instead of hundreds of barrels.

VARIETY OF CROPS GROWN.

Besides the staple market-garden crops of the North which are now extensively grown as truck crops throughout the South Atlantic coast region, there are crops which are more or less peculiar to certain localities. As illustrations, the watermelons of Georgia, the kale of Norfolk, and the sweet potatoes of eastern Maryland and of New Jersey stand out preeminently. The northern areas of the trucking region also are characterized by particular crops adapted to comparatively restricted areas. Eastern Long Island is the seat of the cauliflower and Brussels sprouts industry of the eastern United States, as well as the center for the production of practically all the American-grown cabbage seed.

In general, however, the great commercial trucking industry is based on staple crops which are in continuous demand in the markets, and which, owing to differences in latitude and climatic conditions, may be grown in successive crop zones from southern Florida to Maine. Such crops as lettuce, radishes, peas, beans, potatoes, cabbage, summer squash, and beets are characteristic products of nearly every developed trucking zone along the whole coast. These crops may, indeed, be considered the staple truck crops, as they furnish the basis for profitable truck farming throughout the country. Those few areas which are peculiarly fitted for the production of some special crop, such, for instance, as kale, cauliflower, or Brussels sprouts, have an advantage over other areas which must depend solely on growing the staples.

METHODS OF HANDLING SOME STAPLE TRUCK CROPS.

The methods of growing the staple truck crops differ somewhat in the various crop zones. While no attempt will be made here to present a detailed statement regarding the important truck crops for each of the several crop zones covered by the Atlantic coast States, some of the differences existing between the methods of handling certain standard crops in the various portions of the area will be pointed out.

LETTUCE.

Lettuce is grown as a field crop in Florida, and a lettuce field in that State is shown in Plate XLIX, figure 1. In the vicinity of Charleston, S. C., and Wilmington, N. C., it is handled almost exclusively as

a frame crop, while near New York and Boston it is chiefly grown in forcing houses (see Pl. XLIX, fig. 2). While the products of Florida and Charleston come in competition to some extent with the New York and Boston crops, as a rule these products are quite easily distinguished and naturally gravitate to different districts in the great consuming centers.

CUCUMBERS.

In Florida cucumbers are grown as a field crop. In the vicinity of Charleston and Wilmington they are extensively grown as field crops; at Charleston the plant first appears as a forcing crop, and in the neighborhood of Norfolk it is distinctively a frame crop early in the season, followed by a large field production later on. In the northern portion of the territory cucumbers are grown not only in forcing houses but as a frame product, and also as a field crop for the use of salting stations and pickle factories.

CABBAGE.

Cabbage is even more cosmopolitan than either of the foregoing crops. The methods employed to adapt it to the requirements of the market and to the different areas in the trucking region are very distinct and each forms a chapter in the cultural history of this important truck crop. For instance, at the South cabbage is a winter crop, seeds being sown during September and October, the plants transplanted to the field at the beginning of winter, and kept in a slowly growing condition throughout the colder portion of the year, to be forced rapidly by the addition of stimulating fertilizers early in the spring to supply the demands of the market as the warm weather comes on. This product is naturally very soft and must be consumed with little delay; and, since it is grown on a very extensive scale (see Pl. L, fig. 1), it must be so distributed as to meet only the immediate demands of the market to which it is sent. The importance of this industry can be judged from the fact that it is found in the crop zones from Florida to Norfolk and in areas commensurate with the needs of the market during the periods when the product is supplied by particular zones. As the supply of northern stored cabbage disappears from the market, the product from the extreme South follows closely. This in turn is followed by an intermediate crop grown around Charleston, S. C., where is found the largest acreage of purely truck-crop cabbage in the United States. The area surrounding a single shipping point in this region in 1905 produced a head of cabbage for every inhabitant of the United States.

Farther up the coast, cabbage partially gives way to kale; and, while cabbage is a very important crop, it does not hold supreme sway,

FIG. 1.—A LETTUCE FIELD IN FLORIDA.

FIG. 2.—A LETTUCE HOUSE IN NEW YORK.

FIG. 1.—A DAY'S HARVEST IN A SOUTHERN CABBAGE FIELD.

FIG. 2.—CABBAGES WAITING TO BE UNLOADED AT A SAUERKRAUT FACTORY.

FIG. 1.—SLOOPS LOADED WITH POTATOES IN THE TIDEWATER TRUCKING REGION.

FIG. 2.—AN ONION FIELD IN OHIO.

as it does in the Charleston region. At the North the crop is of a very different character, both in variety and in the method of its cultivation. The great bulk of the northern-grown cabbage may be considered as a truck-crop feature of the general farming in sections where the industry has gained a foothold. The cabbage crop takes a regular place in the farm rotation in those communities where the industry has become a permanent feature. In some sections it forms the chief money crop of the fall season, occupying a position similar to that held by potatoes in other sections.

As a truck crop at the North cabbage follows immediately on the passing of the southern supply, which is marked by the clearing of the fields in the neighborhood of Norfolk. This in turn is followed by domestic cabbage for home consumption or for the manufacture of sauerkraut. In this northern territory only a very small percentage of the crop is produced from fall-sown seed and plants carried through the winter in cold frames. A large part of the early product is produced from plants grown in hotbeds or greenhouses and transferred to the open as soon as weather conditions will permit. The great bulk of the crop which forms the supply of the storage houses and sauerkraut factories, however, is grown as a farm crop from seed sown in seed beds in the open, the plants being transplanted to the field about the 1st of July.

This great crop is measured by thousands of acres and millions of tons. At harvest time, in October and November, it is shipped to the great consuming centers in bulk in carload lots. It is stored by thousands of tons in specially constructed warehouses, to be sent out as the demands of the market will justify during the winter season. It is also manufactured into sauerkraut, which finds its way to the great cities as rapidly as there is a demand for it. A sauerkraut factory with wagons filled with cabbages is shown in Plate L, figure 2.

POTATOES.

The potato must be looked upon as one of the standard commercial crops of the country. While its acreage is not as vast as that of wheat or corn, it holds high rank as a money-producing crop throughout a very large part of the territory of the United States. A familiar scene in the tidewater trucking region is shown in Plate LI, figure 1. In this section sloops are loaded by the farmers and the barrels of potatoes are transferred to railway trains or to steamships at some convenient port.

With this crop the rule that at certain seasons of the year certain localities or sections are relied upon to supply the demands of the market holds good. What is true of the cabbage in regard to methods of handling and marketing is to a less extent true of the

potato. The acreage of potatoes is undoubtedly much greater than that of cabbage, but the methods of treatment are not so varied, because, owing to the tender nature of the plant, even in the extreme southern portion of our continental area, the potato can not be cultivated as a winter crop, as can cabbage and onions. The planting of potatoes must be delayed until the time of hard spring frosts has passed. This places it on the basis of a spring crop, even in Florida, where it is extensively grown to meet the demand of northern cities. In this territory, however, advantage is taken of the use of quick-maturing varieties in order that the demand at the North for early potatoes may be met as the season warms up. Besides the use of early varieties the growers of this territory depend largely upon seed grown in extreme northern localities, it being a well-known fact that seed potatoes from such sources germinate more readily and mature a marketable crop of tubers in less time than home-grown seed. For a number of years, however, there has been considerable interest in and use made of a so-called "second-crop" potato which has been produced in the South, notably in Virginia, Tennessee, and the Carolinas. These second-crop potatoes are normally immature and produce a somewhat earlier crop when used for seed than do the first-crop potatoes of the same region, when it is possible to hold them over for the next spring's planting. One great difficulty which confronts the producers of potatoes in southern territory is the fact that the early-crop potatoes do not keep through the hot weather, and can not, therefore, be retained for seed the next season, the seed supply for this industry being drawn largely from the northern potato-producing sections or from home districts where a second crop is produced. During the last two years, however, the second-crop seed has not been as satisfactory as has the northern-grown seed, particularly where several generations of second-crop seed have been employed. This, therefore, makes the great early-crop territory from Baltimore southward along the Atlantic coast almost wholly dependent for its seed supply upon the northern potato-producing territory.

Strange as it may seem, these large acreages of potatoes which are grown for the early northern market are handled—probably because of the abundant supply of comparatively cheap labor which has always been available—upon a very simple system, the work being done with the crudest tools and chiefly by hand. Potato planters and potato harvesters are practically unknown throughout the South Atlantic coast region. North of Baltimore, however, the character of the potato industry takes on a very different aspect. In this territory improved machinery is the rule on soils adapted to its use. Potato planters, potato-spraying devices, and potato-harvesting implements are extensively employed. The work is done in the most

systematic way for the purpose of economizing labor, which in these areas is such an expensive factor in farm management at the present time.

New Jersey and Long Island constitute an intermediate crop zone in which potatoes are produced that can be harvested to meet the market demands immediately following the close of the season at Norfolk and the Eastern Shore of Virginia. This crop is of such a character, however, that it not only meets the immediate demands but can be stored; thus the growers in this territory share a portion of the high profits of the potato as an early crop which are characteristic of the southern fields, and to some extent also the storage advantages which are characteristic of the northern portion of the Atlantic coast country. The varieties which are selected for this zone are those which mature at the proper season to meet the demands of the market after the southern crop has disappeared and which will bear storage for a portion of the winter at least. If the market at the time the crop comes to maturity is not such as to justify the growers' placing the product in the hands of dealers at once, it is stored, usually on the farm where it is produced, to be gradually disposed of throughout the late fall and early winter months.

Farther north and to the west of this intermediate section, the potato is recognized as a staple money crop with an established place in the farm rotation, taking the place of cabbage in some localities and of celery in others. It is here produced solely to be harvested at the close of the season and either shipped immediately to the centers of consumption or stored upon the farms or at shipping points to be sent to the markets as the demands will warrant. Improved machinery which is adapted to potato growing has been one of the main factors in placing this crop in the regular farm rotation of this territory. Potatoes in this section are grown chiefly for table consumption, for starch manufacture, and for seed to be used throughout the southern truck-farming areas. Immense quantities of this crop find their way to the markets at harvest time, the potatoes being dug, gathered from the field, and transported directly to the cars on which they are shipped in bulk to various cities with population sufficient to handle potatoes in carload lots. In other sections the crop is handled somewhat more conservatively and is stored on the farm or is purchased by dealers and stored in large warehouses, where it is held to meet the demands of the home or export markets. It is only the northern crop which can be looked upon as a staple crop to be held for a suitable market or to be handled as are grains.

The product of southern truck fields is always marketed before it is fully matured. It is, therefore, very perishable and must be handled strictly as a truck crop.

In many southern localities the large acreage of potatoes is handled in a very interesting way through the organization of truck-growing

associations, the officers of the associations being in a position to dictate the destination of the product of any grower, to determine whether or not the product is suitable for placing under the trademark of the association, and to control fully the output from day to day. Because of the different character of the crop at the North such organization and methods are not generally adopted. The northern growers are to a certain extent independent of the market and, since the crop is not perishable to a high degree, can await the time when the market will warrant the sale of the crop.

CELERY.

It is interesting to trace the cultivation of celery in various portions of the trucking region under discussion. In Florida, celery is grown extensively as a winter crop, being placed in the field in October, November, or early December, to be harvested during the spring months. This crop is strictly a truck crop and is highly perishable in its nature, as are many other standard truck crops when grown at the extreme southern limit of their cultivation. The approach of warm weather and the consequent rapid development of many truck crops at the South just as they reach marketable maturity render them highly perishable. At the North, however, many of these same crops begin their period of existence in warm weather and mature as the days grow shorter and the weather cooler. This inversion of the seasons in the two localities produces the result of a perishable crop at the South and one possessing more or less decided keeping qualities at the North. This is true, as has been noted, of potatoes and cabbage, and it is also true of celery.

The main celery crop of the North is usually started in moderately warm weather. It makes a portion of its growth during this season, but makes its most satisfactory development as the cool nights of autumn come on. This makes it possible to produce a celery which can be held either in the ground or in a storage house for a considerable period. While it is possible to store celery, the great bulk of the celery grown at the North finds its way to the market immediately from the field, a small percentage only being placed in storage houses and a small percentage also being trenched in the field. While celery is restricted to comparatively small areas, both at the South and at the North, it is a highly remunerative crop, and in those localities where the soil and climatic conditions favor its development it forms the basis of a very important and profitable trucking industry.

ONIONS.

The onion-growing industry of the United States, as represented in the territory now under discussion, is almost strictly confined to the North. Onions are produced from sets to a small extent for bunch

purposes through portions of the southern half of the Atlantic coast trucking region, but it is in the northern half that the onion crop forms an important factor in the trucking industry. Here on soils adapted to its cultivation the onion is handled as a field crop (see Pl. LI, fig. 2). It may be grown either from seed sown directly in the field where the crop is to mature or by transplanting to the field, after the ground has received careful cultivation and become thoroughly warmed, young plants which have been brought forward in hotbeds or cold frames. The great bulk of the onion crop, however, is produced from seed sown where the crop is to stand.

This crop is handled in much the same way as the potato. While the work connected with its production is almost entirely hand labor, the product is of a nature which admits of placing it in storage and holding it for the demands of the market, thus avoiding the necessity of putting the entire product on the market during the comparatively restricted season of harvest.

BEANS.

Beans figure as a market-garden and truck crop throughout the trucking area under discussion. In the frost-free portion of Florida beans are planted as a fall vegetable to reach the northern markets for the Christmas holidays. These are followed in succession by beans from more northern localities as soon as danger from frost is past, so that the successive crop zones of the Atlantic coast region are capable of maintaining a continuous supply of snap beans in the market throughout the year. At the North the bean figures not only as a market-garden crop to be used as a fresh vegetable but also as a farm crop for canners' use. In that portion of the truck-growing area where the soil is of glacial-drift origin the bean plays an important part as a farm crop. The dry beans, being a staple product, produce a high revenue in many localities.

ASPARAGUS.

Asparagus is practically the only truck crop of a perennial nature. Most plants of this character have well-defined climatic limitations, but asparagus, fortunately, lends itself to a wide diversity of climatic conditions, and while exacting as regards soil is less so than most other perennials. The methods of culture at the South do not differ in any essential particular from those followed at the North. Seasonal differences constitute the foundation for the cultivation of this crop in different zones.

TOMATOES.

The tomato is one of those truck crops which play a double rôle in the hands of the truck grower and the market gardener. At the North the tomato is an important field crop both for market and cannery

purposes and is also extensively forced for winter use. At the South the tomato is grown in the frost-free areas in competition with the forced crop and in anticipation of the field crop of the North. As soon as the field crop from near-by localities becomes available distant shippers are as a rule at a disadvantage.

PEAS.

Peas are an important truck crop both at the South and at the North. The pea presents its chief points of interest not in its methods of culture, but in the matter of harvesting and transportation. When grown for immediate consumption as a green vegetable the pea can be most successfully and profitably handled from localities near the market. There is greater risk connected with the transportation of this crop than any other truck crop save strawberries. Peas when packed in barrel-high Delaware baskets, which are an almost universal package for such use, are very likely to heat in transit if the period exceeds twenty-four hours. The crop is therefore best adapted to quick handling. At the North, where the crop is extensively grown for canning purposes, these objections do not hold, for as a rule the crop is sown broadcast, harvested as is hay, and carried, pods, vines, and all, to the factory, where the peas are thrashed, cleaned, and graded by machinery. The bulk of the product will not stand shipment, and there are usually only a few hours between the time of harvesting and canning the peas. The improved methods of handling the pea crop grown for the canneries are in great measure responsible for the improvement in the quality of the processed product.

CONCLUSION.

From what has been said an idea of the varied adaptations of the different truck crops can be formed. Most of these products occupy the land for a short period only and move with the season through the successive crop zones from southern Florida to Maine. The industry is new and the markets are growing and multiplying, but the crops and the cropping areas must always be kept within the capacity for consumption of the markets. Truck crops are quickly grown and must as a rule be consumed immediately.

With such hazardous crops profits must be high in order to justify the risk. It is an intensive industry, involving a maximum risk and maximum profits. Truck farming offers none of the security of other lines of farming in which staple products are produced.

THE CODLING MOTH OR APPLE WORM.

By A. L. Quaintance,
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INTRODUCTORY.

No insect enemy of fruits, with the possible exception of the San Jose scale, is more generally and effectively treated than the codling moth or apple worm, and its control has become one of the routine features of work in many commercial orchards. The treatment for this insect mostly takes the form of spraying the trees with arsenicals, and great variation is possible in the thoroughness with which the work may be done. Some orchardists are able to reduce the amount of wormy fruit to a very small percentage of the crop, but the majority perhaps fail to obtain best results on account of imperfect spraying and lack of attention to details. In many instances results have been so unsatisfactory as to lead orchardists to doubt the value of the measures recommended, and some hold that these are entirely without merit. While a large amount of fruit is thus needlessly lost through careless spraying there is a still greater aggregate loss in the thousands of small orchards over the country, often of not more than two or three dozen trees, in which spraying is not practiced, the owners not being informed regarding the value of such work or the orchard interest not appearing sufficient to warrant the necessary expense.

Notwithstanding the considerable amount of spraying at present practiced against the codling moth its injuries still continue to be very great, resulting in an estimated shrinkage in the value of the apple crop of the United States of approximately $12,000,000 annually; and if account be taken of the expenses incurred in its control for labor, arsenicals, and spraying apparatus an additional sum of probably not less than $3,000,000 or $4,000,000 must be charged to the presence of this insect in the apple orchards of the United States. More thorough and timely spraying where the practice is already established and the adoption of such work where heretofore neglected will result in a great lessening of the present heavy loss suffered from this pest.

CHARACTER OF INJURY.

Wormy apples (see Pl. LIII, figs. 1 and 2) are familiar to all growers and consumers of this fruit, and many have seen, on cutting open an apple, the small, pinkish larva about three-fourths of an inch long, the cause of all the mischief. Injury is done only in the larval or

worm stage of the insect, the larva spending the greater portion of its life within the fruit feeding on the substance of the apple, rendering it more or less worthless and always of inferior grade. Infestation is generally indicated by a mass of brown frass protruded from the calyx end or elsewhere, marking the place of entry of the larva.

The effect of the injury will vary according to the degree of maturity and the variety of apple attacked. Injury by the first generation of larvæ to the green fruit in early summer will cause most of it to fall, and wormy apples comprise a considerable proportion of the so-called "June drop." With some fall and winter varieties fruit injured early in the season may remain on the trees, especially if the injury has not been serious. Later appearing larvæ, as of the second generation, do not cause serious dropping of fruit, though the extent of this will depend much on the amount and violence of the wind. The injury, however, will, except when occurring quite late in the season, cause the fruit to ripen prematurely.

The amount of depreciation in the value of the fruit will vary according to the character of the injury. Apples which have been penetrated to the core and in which larvæ have fed until full grown are practically valueless, except for purposes of cider or vinegar. Fruit with only a slight surface blemish on the sides or ends is injured mostly in keeping qualities and in appearance, and may have considerable value for ready sale, though it would not be suitable stock for placing in cold storage. In the Middle Western and Eastern States especially, considerable fruit which is more or less injured by the codling moth finds its way into barrels with first-class stock, greatly depreciating the value of the latter. More care is necessary in grading to exclude all wormy fruit, as it often happens that the poorest and not the best fruit in the package determines its market value.

LIFE HISTORY AND HABITS.

Since the time of Cato the codling moth has been written about by practically all entomologists, and the combined literature on this species, from nearly all countries of the world, would amount to several good-sized volumes. Nevertheless, it is only within comparatively recent years that a fairly complete account of the life and habits of the insect has been presented, and beliefs formerly current have been shown to be erroneous.[a] At the present time numerous impor-

[a] Special mention should be made of the work of Doctor Howard (Rept. Com. Agric. 1887, p. 88); Card (Bul. 51, Nebr. Agric. Exp. Sta., 1897); Slingerland (Bul. 142, Cornell Univ. Agric. Exp. Sta., 1898); Gillette (Bul. 31, n. s., Div. Ent., U. S. Dept. Agric., 1902); Simpson (Bul. 41, Div. Ent., U. S. Dept. Agric., 1903); Ball (Bul. 95, Utah Agric. Exp. Sta., 1906); Melander & Jenne (Bul. 77, Wash. Agric. Exp. Sta., 1906); and of Professors Washburn, Aldrich, Cooley, Cordley, Pettit, Woodworth, Lloyd, Sanderson, and others, who have all contributed to our present knowledge of the insect, and methods of control.

tant points in the biology and treatment of the codling moth need further investigation in various parts of the country to secure data on its behavior under varying seasonal and climatic conditions. The question of the number of generations of the codling moth in different portions of the United States has not been accurately determined, especially in the South and Southwest. The great importance of the insect as an apple pest warrants the fullest investigation of these and other points.

The codling moth, like all insects of the order Lepidoptera, or butterflies and moths, to which it belongs, presents four distinct stages in its life, namely, the egg, the larva or worm, the pupa, and the adult or parent moth.

THE EGG.

The egg of the codling moth is disk-like, somewhat oval in shape, and about the size of a pin head, the shorter diameter varying from 0.96 to 1 mm. and the longer from 1.17 to 1.32 mm. On the surface is a network of lines which becomes coarser toward the flange-like margin. The eggs are glued tightly to the foliage or fruit, appearing under reflected light as a glistening white spot. The egg stage was fully described in 1893. Until about ten years ago the idea generally prevailed that the eggs were deposited either in the blossom end or the stem end of the apple, since the entrance holes of the larvæ were usually found at these places. Professor Card in 1897 found that the eggs of the first generation of moths were laid mostly on the foliage, and similar observations were made by Simpson in Idaho in 1901–2, and these conclusions have been fully verified by other workers. In oviposition the moth seeks a smooth place, as the upper surface of a leaf, the pilose or downy condition of the young fruit at this time rendering it unsuitable for egg-laying purposes.

Moths of the second brood, on the other hand, deposit the majority of their eggs on the fruit, which by midsummer and later is smooth and more conspicuous. The distribution of the eggs over the plant has an important bearing on the question of the insect's control, as will be pointed out in describing the habits of the young larva. The number of eggs deposited by one female has not been definitely determined, the records (incomplete in some instances) of moths in confinement ranging from 21 to 85. The maximum number under orchard conditions is thought to be not over about 50. Oviposition probably occurs mostly in the late afternoon or early evening, or, according to some writers, at night. The period of incubation will vary considerably, depending on temperature conditions, and eggs are deposited at different stages of embryonic development. Eggs laid by first-appearing moths of the spring generation are usually subjected to a lower mean temperature than those deposited by this generation several weeks later. Observations by Simpson on the egg stage under orchard conditions show this to vary between

nine and eighteen days, with an average of about eleven days. Other observers have found it to be somewhat less, though the observations were made mostly with eggs under indoor conditions.

THE LARVA.

It is in the larval or "worm" stage only that injury is done. At the time of hatching the larva is of a whitish or yellowish color, measuring from one-twentieth to one-sixteenth of an inch in length. The head is proportionately large and shiny black. The cervical and anal shields are dark, and the body is dotted with regularly arranged tubercles, each with a short hair or seta.

When full grown the apple worm measures about three-quarters of an inch (19 mm.) in length; the body is of a pinkish flesh color above, becoming whitish below, the general color varying from pinkish to much lighter. The head is brown with darker markings and varies in width from 1.54 to 1.76 mm. The cervical and anal shields are much lighter. There are 3 pairs of well-developed thoracic legs, 4 pairs of fleshy abdominal, and a pair of anal prolegs. (See Pl. LII, fig. 2.)

The young larvæ, upon hatching from eggs placed on the leaves, at once begin their search for the fruit, and a variable time will elapse before this is reached, depending upon its proximity and abundance. Simpson notes instances where eggs were deposited 10 to 20 feet from the fruit, and it is questionable if in such cases the larvæ would find the fruit before succumbing to destructive influences. When hatched upon foliage it is stated [a] that the larvæ feed upon this before the fruit is found, though more data upon the leaf-feeding habits of the larva under orchard conditions are desirable. This leaf-feeding habit, however, has been frequently observed with larvæ in confinement. It is thus possible, by poisoning the foliage, to destroy the larvæ just after they have escaped from the egg and before they reach and injure the fruit.

Larvæ from eggs placed on the fruit at once—or upon finding the fruit, if from eggs placed elsewhere—seek a place to enter, as at the calyx, or less usually at the stem end, or some roughness on the surface, or where two apples are in contact or touched by a leaf. The greater part of the first-brood larvæ enter the apples at the calyx end either between the lobes or by boring through these at the base. Numerous workers have investigated this point, and the larvæ of the first brood entering the fruit at the calyx end are stated to be from 60 to 80 per cent. Careful counts by Simpson in 1901 gave an average of 83 per cent with a minimum of 79 per cent, and more extended observations during the following year gave a maximum of

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[a] Bul. 51, Nebr. Agric. Exp. Sta., p. 18 (1897); Bul. 222, Mich. Agric. Exp. Sta., p. 90 (1904); Bul. 131, N. H. Agric. Exp. Sta., p. 22 (1907).

93 and a minimum of 50, the average being 81 per cent. According to the same investigator less than one-half of 1 per cent enter at the stem end, the remainder going in on the side. These figures are very important in connection with the fact that the young larvæ feed within the calyx cavity for a few days before boring into the interior. This permits of their destruction by spraying into the calyx cavity, while the lobes are still open, a dose of poison to be eaten with their first meal. Upon arriving within the calyx cavity the larva begins to feed and a few days later, as is true when the fruit is entered at the side, eats its way to the center, where it arrives in about a week and when about one-fourth grown. Here it feeds upon the seeds and flesh around the core until it has attained its growth. When penetrating to the core, the larva keeps its burrow clear by pushing to the outside the portions of excrement, and this brown frass in the blossom end or elsewhere is the usual indication of infestation by this species. (See Pl. LIII, fig. 1.)

Larvæ of the second brood, unfortunately, do not enter the fruit at the calyx end to the extent that is true for those of the first generation, which renders them more difficult to combat. In fact, injury by the larvæ of this generation is best avoided by thorough work against those of the first, destroying them as much as possible. Statistics by Simpson indicate that only 26 to 28 per cent of second-brood larvæ enter the calyx end, as against 81 to 83 per cent of the first brood.

The time spent in the fruit varies considerably and is variously stated at from ten to thirty days, with an average of about twenty days. Observations on this point with second-brood larvæ by Messrs. Melander and Jenne in Washington show a range of eighteen to thirty days, the average being about twenty-three days. Preparatory to leaving the fruit the apple worm bores a hole to the exterior, rarely along the entrance burrow, but in another direction, keeping the orifice closed, however, with a silken cap or plugging the hole with excrement until ready to desert the fruit. The time of leaving the fruit is, during warm weather, mostly at night, but later in the season, when nights are cool, this occurs more often during the day. Once outside of the fruit, when this is on the tree, the larvæ mostly crawl from the fruits to the twigs and thence down to the larger branches or trunk, and, finding a suitable crack, hole, or bark scale, begin at once to spin a cocoon. On smooth-barked trees many go to the ground, penetrating the cracks at the base of the tree or going under rubbish or clods. Most larvæ desert the apples before these drop, but when they fall with the fruit the caterpillars simply crawl to some near-by protection and there spin their cocoons. The larvæ will pupate in large numbers under objects leaning against the tree or in bands of hay, burlap, or other material tied around the limbs and trunks. Banding to thus trap the larvæ has long been practiced

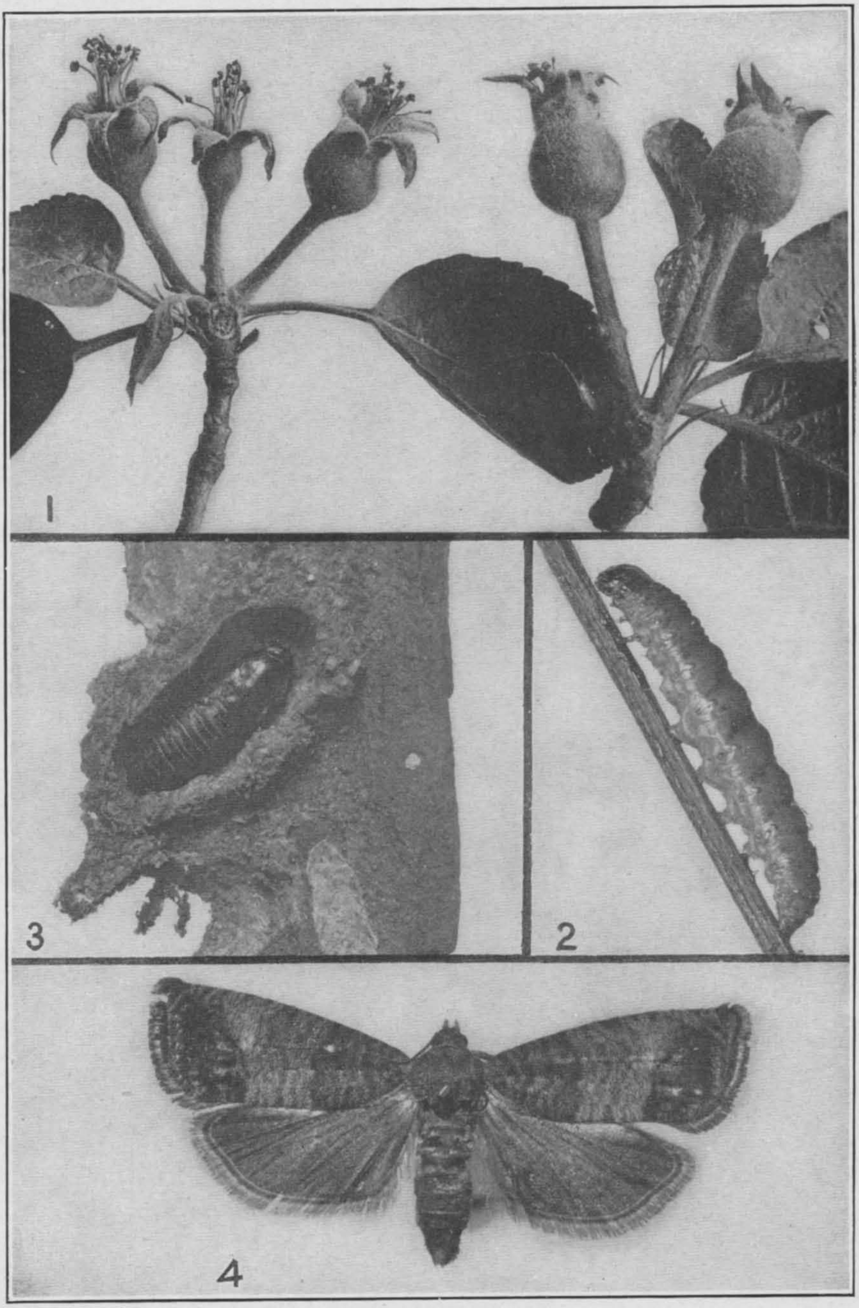
in the control of the codling moth, and before the accidental discovery in 1878 of the value of arsenical sprays this method, together with the gathering of fallen fruits, was mostly relied upon to keep the pest in subjection.

THE COCOON AND PUPA.

All through its life the larva spins from a tube on the lower lip a silken thread useful in various ways and especially for making, when full grown, a protecting covering or cocoon within which to change to the pupal stage. Having found a suitable place it begins to weave about itself, strand by strand, a covering of whitish silk, elongate or capsular in shape, but conforming to the cavity where situated. About a day is occupied in constructing the cocoon, within which, if late in the season or in regions where there is but one annual generation, the larva will remain in hibernation until the following spring, or, in regions where climatic conditions favor another generation, the body contracts in length, its segments become more distinct, and in three or four days the larval skin is shed and the pupal stage entered.

The pupa is about half an inch long, varying according to age from a yellow to brown color, becoming of a bronze hue shortly before the moth is to emerge. The abdominal segments above, except the first, are armed each with two rows of backward-pointed, short, stout spines, there being but one row, however, on the two caudal segments. These spines are used by the pupa in pushing itself partly out of the cocoon to permit the escape of the moth. The wing and leg sheaths reach about the middle of the fourth abdominal segment, the antennal sheaths being slightly shorter. The cremaster is composed of a sparse circle of slender hairs, slightly curved at the tip, which assist in holding the pupa in place in the cocoon. (See Pl. LII, fig. 3.)

The time spent in the pupal stage is variable. This period in the spring, with over-wintering larvæ, according to Messrs. Melander and Jenne, varied from twenty-one to thirty-six days, with an average of about twenty-eight days, while in 1905, owing to a cooler spring, the range was twenty-nine to fifty-one days, with an average of about forty-three days. The time spent in the cocoon during summer is shorter; thus, according to the authorities mentioned above, the average during June and July is about twenty-two days, and during August and later, thirty-four days. Records by Professor Gillette in 1900 give a maximum of twenty-nine days, a minimum of twelve days, and an average of twenty days. Records by Simpson in 1902 give an average minimum of fourteen days, and in 1902 the period varied from eleven to forty-nine days, the average being twenty-two days. In general, for the country as a whole, the time spent by the larva and pupa in the cocoon will average not far from



THE CODLING MOTH AND ITS CONTROL.

[Fig. 1.—Young apples, showing, on left, calyx lobes open, and in right condition for first spraying; on right, calyx lobes closed, and almost, if not quite, too late for first spraying. Fig. 2.—The codling moth larva, or apple worm. Fig. 3.—Codling moth pupa, in its cocoon, under scale of bark from trunk of apple tree. Fig. 4.—Codling moth, or parent of apple worm. Figures 2, 3, and 4 enlarged about three times. (Original.)]

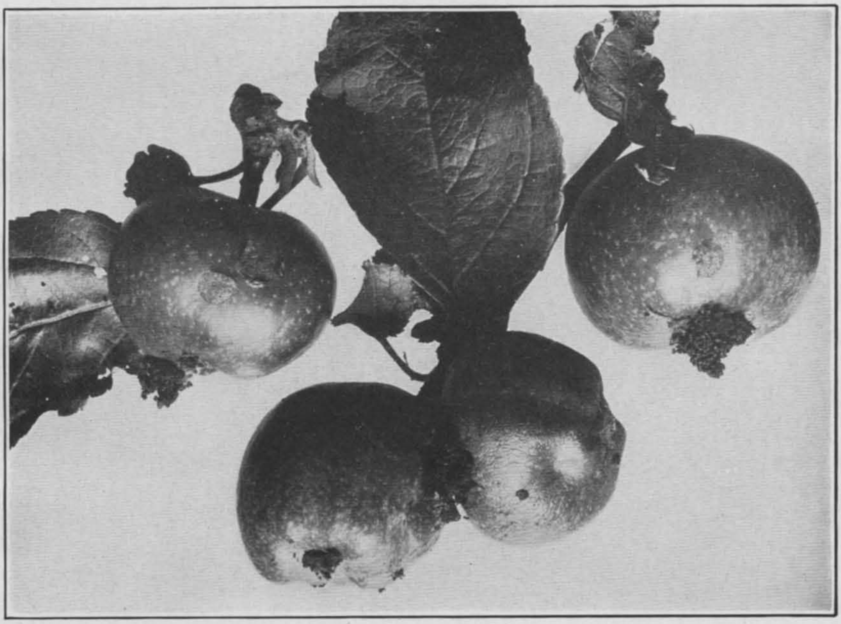


FIG. 1.—YOUNG APPLES, SHOWING FRASS AT CALYX END AND WHERE APPLES ARE IN CONTACT, THE WORK OF LARVÆ OF FIRST GENERATION OF THE CODLING MOTH. SOMEWHAT REDUCED. (ORIGINAL.)

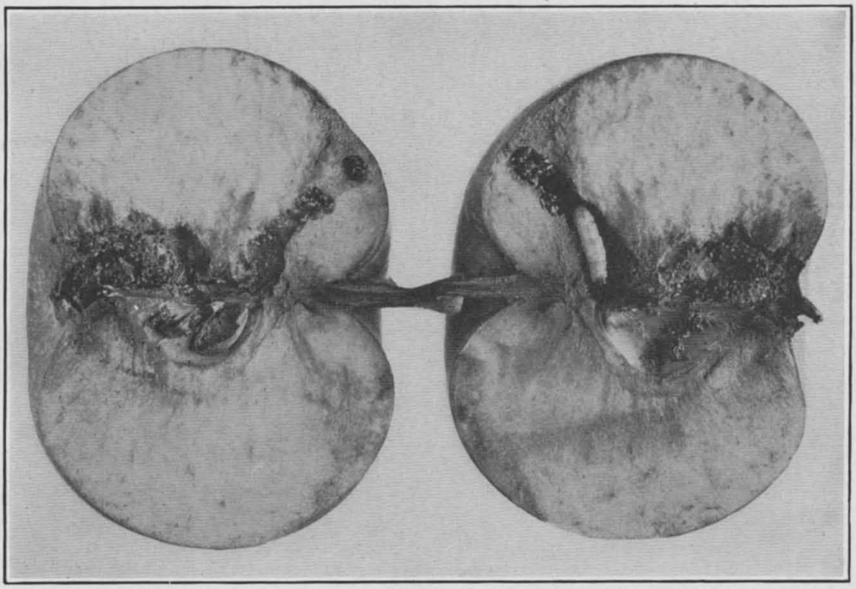


FIG. 2.—MATURE APPLE CUT OPEN, SHOWING APPLE WORM OF SECOND GENERATION AND ITS WORK. SOMEWHAT REDUCED. (ORIGINAL.)

WORK OF THE CODLING MOTH OR APPLE WORM.

twenty days. These data, especially the minimum periods of life in the cocoon, are important in connection with the use of bands, to be mentioned under the head of remedies, as indicating how frequently these should be examined to avoid the development and escape of the moths. When the pupa is matured it works half way out from the cocoon, the skin splits down the back, and the adult quickly escapes by pushing away the head end of the pupal skin. The moth, at first wet and with soft integument and crumpled wings, soon dries, the wings expand, and the insect disappears in the foliage, the whole process requiring not more than fifteen or twenty minutes. In a few days the sexes mate and the females begin the deposition of eggs.

THE ADULT OR MOTH.

The adult codling moth is variable in size, the wing expanse, however, never exceeding three-quarters of an inch. The forewings have a brownish-gray silky appearance, being crossed with dark and white lines, and near the tip is a brownish-colored spot or ocellus in which are two irregular lines of a metallic coppery or golden color. The hind wings above are grayish-brown, darker toward the margin, which bears a delicate fringe, at base of which is a narrow dark line. The color of the moth is such that when at rest with folded wings on the grayish bark of an apple tree it so harmonizes with its surroundings that it is not readily distinguished, and this stage is not ordinarily seen by orchardists. (See Pl. LII, fig. 4.)

The males and females are readily distinguished, the male exhibiting on the lower surface of the front wing an elongate blackish spot, and this sex also has penciled, long, black hairs on the upper surface of the hind wings. In the orchards the moths are said to rest commonly on the upper surfaces of leaves or on the trunks of the trees. When disturbed their flight is rapid and erratic, and can not long be followed. The food is possibly nectar from flowers, juice of ripe apples, etc., as they feed in confinement on sweetish juices and also on water.

The length of life of the moth will depend much on the surrounding conditions. Records vary from one to fifteen or seventeen days; the average life of 47 moths in August, 1902, without water or food, as stated by Simpson, was four days. Unquestionably with food they live much longer, and moths appearing in late fall may survive several weeks, though they never hibernate, so far as observed.

LENGTH OF LIFE.

The average time for the respective stages, as stated in the foregoing, is, for the egg, eleven days; the larva, twenty days; the pupa, twenty days, and with five days intervening from the emergence of the moth until egg-laying begins, there is a total of fifty-six days.

Records for the summer brood by Professor Gillette in Colorado give, for the egg, seven days; the larva, nineteen days; the pupa, eighteen days; and with five days from emergence of moth to middle of egg laying, there is a total of forty-nine days. In general, it may be said that the life cycle requires some seven to eight weeks.

NUMBER OF GENERATIONS.

Despite the large amount of work which has been done on this species, there is yet need of information regarding the number of generations each year in different parts of the United States, and on the proportion of first-generation larvæ which transform for the second generation in regions where this latter is not a full one. As is at once apparent, knowledge on this subject is of much practical importance as bearing on the treatment to be employed. Where there is a large partial or full second generation the injury is notably greater. In general, however, it may be said that throughout the New England States and southward at least to the latitude of Washington there is one full generation each year and a partial second. In the northernmost part of the territory indicated, as in Maine and New York, the second generation of larvæ will be light, varying in extent from season to season, while in the southern portion it becomes quite large and during favorable years it is practically a full one. Two full generations have been reported by Pettit for Michigan, and, according to Messrs. Green and Houser, it is thought that this condition will be found to obtain in Ohio. Adequate data are not at hand for other Central States of about this latitude. A full second generation of larvæ was determined by Mr. Dudley Moulton of this Bureau for Nebraska City, Nebr., in 1906. Riley records two generations for Missouri, and the same condition has been shown for Iowa by Walton and also indicated by Gillette. In the latitude of Chicago, as stated by Le Baron, a great majority of first-brood larvæ transform to moths during the last two weeks in July. In general, for these Middle States it would appear that the insect is two-brooded or that the second is of sufficient extent to warrant its being so considered for practical purposes. In States of the latitude of Virginia, Kentucky, Kansas, and Colorado two full generations may be expected each year. Careful studies have shown that there are two full generations in States of the far West, as Washington, Oregon, Idaho, Montana, Utah, California, and Colorado. Band records in New Mexico, by Prof. Fabian Garcia, seem to show that the codling moth is in that Territory three-brooded, and at Siloam Springs, Ark., during 1907, Mr. E. L. Jenne, of this Bureau, obtained practically a full third brood in breeding cages, though it does not follow that this condition would obtain in orchards.

NATURAL ENEMIES.

While the codling moth in its several stages is subject to attack from numerous natural enemies, the number is smaller than for many other lepidopterous insects leading a more exposed life. The eggs are parasitized by a very minute four-winged fly, *Trichogramma pretiosa* Riley, which deposits her eggs in those of the codling moth, three or four grubs or larvæ finding sufficient food for their development to the adult condition in a single codling-moth egg. The larva, although living most of its life protected within the apple, is nevertheless parasitized by several species of hymenopterous insects, as *Pimpla annulipes* Brullé, *Macrocentrus delicatus* Cress., *Goniozus* sp., *Bethylus* sp., and a tachinid fly, *Hypostena variabilis* Coq. Numerous parasites attack the codling moth in Europe,[a] among which are *Campoplex pomorum* Ratz., *Pristomerus vulnerator* Panz., *Phygadeuon brevis* Riley, and *Calliephialtes messor* Grav. The last of these has been recently introduced into California by the horticultural commission of that State to prey upon the codling moth. Numerous predaceous insects in their larval stage have been recorded as preying upon the codling moth, though some are possibly merely scavengers, feeding upon the insect after death. Among these are *Chauliognathus pennsylvanicus* DeG., *C. marginatus* Fab., *Telephorus bilineatus* Say, *Tenebrioides corticallis* Mels., *T. laticollis* Horn, *Trogoderma tarsale* Mels., *Pterostichus californicus* Dej., and *Calathus* sp. A raphidid (*Rhaphidia* sp.) is an enemy of the codling moth in the far West, searching out and destroying the larvæ under bands. In Utah a wasp (Ammophila) has been found stocking its burrows with codling-moth larvæ, and in California *Sphecius nevadensis* Cress. has been seen pulling the larvæ from their burrows.

Birds constitute by far the most important natural enemies of the codling moth, especially woodpeckers, and it is highly probable that most of those frequenting orchards include the codling moth in their diet. So diligently do the woodpeckers search over the trees for the hibernating larvæ that by spring these have been largely destroyed in the more exposed situations. The benefit derived from the work of these birds warrants their protection and encouragement to the fullest extent possible. The species of birds definitely recorded as feeding on the codling moth are as follows: Downy woodpecker (*Dryobates pubescens*), Texan woodpecker (*Dryobates s. bairdi*), red-headed woodpecker (*Melanerpes erythrocephalus*), red-shafted flicker (*Colaptes cafer*), kingbird (*Tyrannus tyrannus*), magpie (*Pica pica hudsonia*), crow (*Corvus brachyrhynchos*), crow blackbird (*Quiscalus quiscula*), cardinal (*Cardinalis cardinalis*), black-headed gros-

[a] See J. T. Schreiner, in Zeitschrift für Wissenschaftliche Insektenbiologie, Heft VII, December 9, 1907.

beak (*Zamelodia melanocephala*), warbling vireo (*Vireo gilvus*), chickadee (*Parus atricapillus*), bush-tit (*Psaltriparus minimus*), and bluebird (*Sialia sialis*). There are indefinite records of the following birds feeding on the codling moth: Sparrows, swallows, jays, wrens, creepers, and nuthatches.

METHODS OF CONTROL.

The codling moth is best controlled by the use of arsenical insecticides sprayed on the trees. The application of the arsenical in States eastward of about the Rocky Mountains is usually made with Bordeaux mixture,[a] effecting a combination treatment for the codling moth and fungous diseases of the fruit and foliage of the apple as well. The arsenical also controls canker-worms, the tent caterpillar, and a number of other bud and leaf feeding insects, and affords much protection against the plum and apple curculios.

In regions where fungicides are unnecessary the arsenical is applied in water, preferably with the addition of a small quantity of freshly slaked lime (1 to 2 pounds for each 50 gallons of water) to prevent as much as possible any caustic action of the poison on the foliage; with arsenicals such as Paris green the lime also serves to show how thoroughly the spraying is being done.

USE OF ARSENICALS.

Paris green, arsenate of lead, arsenite of lime, and Scheele's green are the principal poisons used against the codling moth and in about the order named.

PARIS GREEN.

Paris green is used on apple at the rate of about 1 pound to 150 gallons of Bordeaux mixture or water. One pound to 100 gallons will frequently prove too strong, causing serious burning of the foliage. The dry poison is first worked into a paste with water to insure its better distribution in the liquid.

ARSENATE OF LEAD.

Arsenate of lead is deservedly coming into very general use for the codling moth and bids fair largely to supplant other poisons. Its advantages are (1) that it sticks well to foliage and to fruit, not being readily washed off by rains; (2) the complete absence of free arsenic in properly made preparations, so that it may be used quite strong without danger of injury, and (3) its white color, by which it is possible to tell how thoroughly spraying is being done. It is used at the rate of 4 to 6 pounds to each 100 gallons of Bordeaux mixture or water. As found on the market it usually comes in the form of a putty-like paste which must be worked free in a little water

[a] See Farmers' Bulletin 283, U. S. Dept. Agric., "Spraying for Apple Diseases and the Codling Moth in the Ozarks," p. 34 (1907).

before addition to the spray tank. There are now numerous brands of arsenate of lead on the market and the prospective user should be careful to buy an efficient and safe kind. A satisfactory kind should be practically free from salt (NaCl) and by-products, should contain no free arsenic, and should have as much as 50 per cent actual arsenate of lead.

This arsenical may be prepared at home from the ingredients used in its commercial manufacture, as arsenate of soda and acetate of lead. Except where used on a considerable scale it will, however, be advisable to employ a reliable commercial product. In purchasing the ingredients for the homemade arsenate of lead the dealer or manufacturer should be required to furnish a guaranteed analysis of the ingredients and to indicate the exact amounts of each, by weight, which should be employed to produce complete combination.

ARSENITE OF LIME.

Arsenite of lime is the cheapest of the arsenical poisons and has proved to be satisfactory on apples when properly prepared. The Kedzie formula is as follows: White arsenic, 1 pound; sal soda crystals, 4 pounds; water, 1 gallon. All of the ingredients are boiled together in an iron vessel for fifteen minutes or until the arsenic dissolves, leaving only a small quantity of muddy sediment. Any water lost by evaporation should be replaced. This constitutes a stock solution, and 1 pint is approximately equal in arsenic content to 4 ounces of Paris green. When desired for use 1 or 1½ pints is added to each 50 gallons of the Bordeaux mixture or water. When used in water there must be added the milk of lime made from slaking 3 or 4 pounds of good stone lime which is necessary to produce the arsenite of lime.

A still cheaper method (Taft's formula) is to boil together for forty minutes 1 pound of white arsenic and 2 pounds of lime in 2 gallons of water, which is sufficient for 300 to 400 gallons of spray liquid. There is always danger of incomplete union of the arsenic and lime and injury to the foliage may result; 3 to 4 pounds of fresh-slaked lime should always be added to the spray tank before using.

SCHEELE'S GREEN.

Scheele's green is very similar to Paris green, but cheaper, as it does not contain any acetic acid. It is a finer powder, remaining in suspension longer, and is used in the same way and at the same strength recommended for Paris green.

SPRAYING APPARATUS.

The orchardist can not expect best results in fighting the codling moth and other insects and diseases of the apple unless he be provided with efficient spraying apparatus. Principally three types of spray pumps are used in orchards, namely, the barrel pump, the

hand-power tank outfit, and the gasoline sprayer. In the first the pump, according to its design, is fitted to the end or side of a 50-gallon barrel, which is placed in a wagon, or (less usually) carried on wheels or on a sled. The pump should be fitted with two 20 or 25 foot leads of hose, bamboo extension rods, and double nozzles, and if of proper construction there should be no trouble in obtaining suitable pressure for effective work. Barrel pumps are used mostly in small orchards.

Tank outfits are desirable for larger orchards, and consist of half-round tanks holding from 100 to 300 gallons, flat on top and fitted to the wagon in place of the wagon bed. Hogshead tanks of 100 to 200 gallons each placed upon one end of the wagon are also used. The barrel type of pump may be employed with these tanks, but it is preferable to use the large tank pumps made for the purpose, with double cylinders and with suction hose. Such a pump (see Pl. LIV, fig. 2), if properly run, gives excellent pressure with two 20 or 25 foot leads of hose, and with double or even triple nozzles.

When the orchard interest warrants, however, a gasoline or other power outfit should be used which will maintain a pressure of 125 to 150 pounds, with several leads of hose and double, triple, or quadruple nozzles. A high pressure results in a fine, mist-like spray, penetrating to all parts of the tree, insuring a thorough and even distribution of the poison. (See Pl. LIV, fig. 1.)

A common defect in many outfits is that the hose is not of sufficient length; it should be long enough to admit of spraying on all sides of a tree before leaving it. Inadequate provision for agitating the liquid in the tank is another common defect. This results in uneven distribution of the poison. Extension rods 10 to 16 feet in length are indispensable, and a derrick or platform should be provided on the wagon on which one or more men may stand to spray the higher parts of the tree while men on the ground are spraying as high as may be reached. One of the most important features of the spraying outfit is the nozzle. The Vermorel type, with medium to small apertures, is best. The orchardist should not make the mistake of fitting an otherwise good outfit with poor nozzles.

SCHEDULE OF APPLICATIONS.

First application.—This should be made as soon as the petals or blossoms have fallen, and has for its object the placing in the calyx cavity of each little apple a dose of poison to be later eaten by the larva as it seeks to enter the fruit. This is much the most important of all treatments. At this time the young apples are mostly upright on the stems, and much more effective work may be done by spraying from above downward. Between the extension rod and the nozzle, for this spraying, an elbow fitting should be used, or the cham-

FIG. 1.—HAND POWER TANK OUTFIT USED IN SPRAYING EXPERIMENTS AND DEMONSTRATIONS BY BUREAU OF ENTOMOLOGY IN VIRGINIA, 1907. (ORIGINAL.)

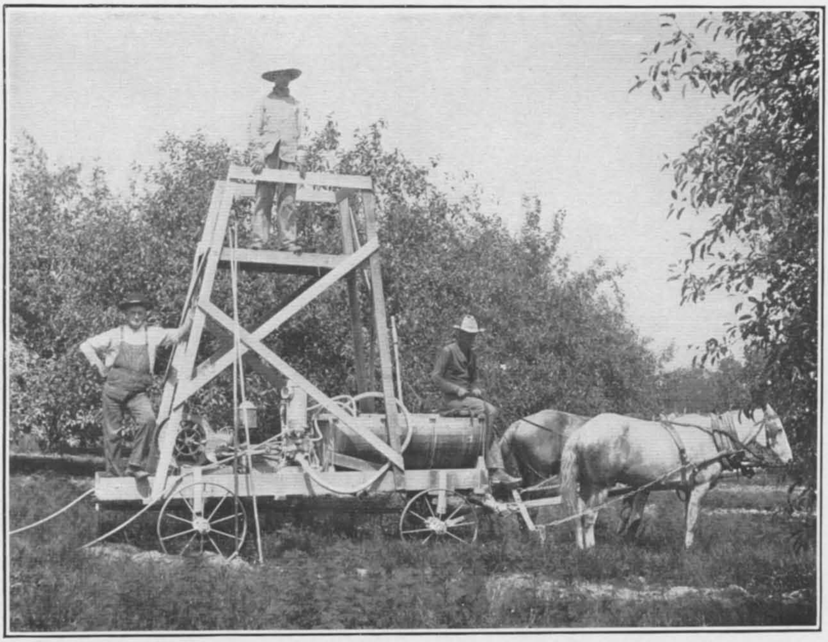


FIG. 2.—GASOLENE POWER OUTFIT USED IN SPRAYING EXPERIMENTS AND DEMONSTRATIONS BY BUREAU OF ENTOMOLOGY IN ARKANSAS, 1907. (ORIGINAL.)

SPRAYING OUTFITS FOR THE CODLING MOTH.

FIG. 1.—CROP FROM ONE TREE OF BEN DAVIS VARIETY SPRAYED SIX TIMES FOR FRUIT DISEASES AND THE CODLING MOTH; SOUND FRUIT IN PILE, WORMY FRUIT IN BASKET. NINETY-THREE AND FIVE-TENTHS PER CENT FREE FROM CODLING MOTH.

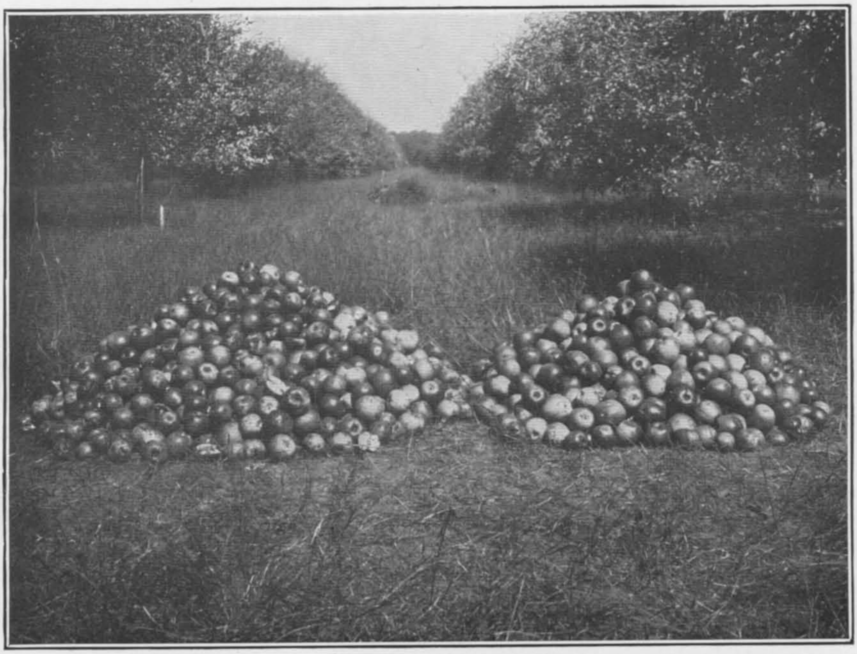


FIG. 2.—CROP FROM ADJACENT TREE OF BEN DAVIS VARIETY, UNSPRAYED; SOUND FRUIT IN PILE TO RIGHT, WORMY FRUIT IN PILE TO LEFT. ONLY 41.8 PER CENT FREE FROM CODLING MOTH INJURY.

BENEFITS OF SPRAYING FOR THE CODLING MOTH.

ber portion of the nozzle may be turned at an angle of about 45° from the long axis of the rod. Recent experiments by Professors Ball in Utah and Melander in Washington show that this first application should be excessive, spraying the trees until thoroughly drenched to insure the poisoning as nearly as possible of every apple. Such spraying at this time has been found to result in the destruction of nearly all of the first-brood larvæ entering the calyx and two-thirds of those of the second brood entering at this place. Such excessive spraying, while feasible in the arid regions of the West, can not be recommended without modification for the more Eastern States where an arsenical is combined with Bordeaux mixture for codling moth and apple scab, as the excessive use of Bordeaux mixture at this time would likely result in severe injury to foliage and russeting of the fruit. There is also danger of injury from such excessive use of any of the arsenicals except well-prepared arsenate of lead. Danger of injury would doubtless be greatly lessened by using a reduced strength of arsenate of lead—say 1 pound to 50 gallons of water—and Bordeaux mixture of about one-third the usual strength; the excessive treatment will insure at least a normal amount of these compounds on the tree when completely sprayed. This treatment should be completed within seven or eight days from the falling of the petals, since by this time the calyx lobes begin to close, interfering with the lodgment of the poison in the calyx cavities. (See Pl. LII, fig. 1.)

Second application.—In view of the fact that the eggs of the first brood are scattered quite generally over the foliage and twigs and that the resulting larvæ feed more or less on the leaves during their wandering in search of the fruit, it would appear certain that many of these will be killed by poisoning the fruit and foliage. The period of maximum hatching of the larvæ from these eggs, while varying considerably from season to season, will on the average be about three or four weeks from the falling of the blossoms or petals, and a thorough application of the poison should be made at this time, using a fine, mist-like spray and paying special attention to covering the fruit and foliage thoroughly.

The first and second treatments are advised for all sections of the country, and if thoroughly done should be sufficient for regions where the second brood is light, as in the New England States, especially if there is but little infestation from near-by unsprayed orchards. Also these two treatments, if very thorough, should be sufficient in more or less isolated orchards where the second brood is nearly or practically a full one, and which are being regularly sprayed from year to year. In the upper tier of Eastern, Middle, and Western States, as New Jersey, Ohio, and Iowa, the second generation will be so nearly a full one as to warrant a third or even a fourth spraying. In States of the latitude of Virginia, Kentucky, Kansas, and

Colorado, and in practically all of the Western States, as Montana, Idaho, Utah, Oregon, Washington, California, and New Mexico, where a full second brood is recorded, with, in some sections, the possibility of a third, the four treatments will be necessary, and a fifth where outside infestation of orchards by the second brood of moths is serious.

THIRD APPLICATION.—This is the first treatment for the second generation of larvæ and should be made nine or ten weeks from the falling of the petals.

FOURTH APPLICATION.—The fourth application should be made two or three weeks after the third.

FIFTH APPLICATION.—The fifth application should be made two or three weeks after the fourth.

BENEFITS OF SPRAYING.

A large amount of data has been presented in entomological and horticultural literature showing the great benefits following spraying for the codling moth. Wherever this insect exists spraying will be found exceedingly profitable; indeed, in most sections successful apple culture depends upon its control. In those parts of the country where it is necessary to prevent also fungous diseases of the fruit and foliage, as apple scab, bitter rot, Phyllosticta, and leaf spot, the arsenical and fungicide should be used together, effecting a combination treatment for these several troubles which should result in a high percentage of sound, bright fruit at picking time.

During the past two years the Bureau of Entomology,[a] in connection with other work on deciduous fruit insects at several of its temporary field stations, has been carrying out experiments and demonstrations in spraying for the codling moth as a part of an investigation of this species for the country as a whole. In the table on page 449 some results of the demonstration spraying are shown. The percentages of wormy fruit and of fruit free from worms together include the total fruit of the trees indicated. Account has been taken of all of the fruit produced by the tree, whether it fell to the ground during the season or remained on trees until picking time. In each case the demonstration included a considerably larger number of trees than were used for determining results.

The treatment in all cases was 5 or 6 ounces of Paris green or 2 pounds arsenate of lead to each 50 gallons of standard Bordeaux mixture. The percentage of crop protected from codling-moth injury is seen to vary from 32.4 to 72.21, the average of all the percentages being 54.54, somewhat more than one-half of the crop. Any orchardist, by thorough work, can do as well or better.

[a] The work in Arkansas and Missouri was done in cooperation with Prof. M. M. Scott, of the Bureau of Plant Industry, and in Missouri, with the Missouri Fruit Experiment Station.

Some results of demonstration spraying for the codling moth, 1906–7.

Locality.	Trees counted.	Variety.	Applications.	Fruit wormy.	Fruit not wormy.	Crop protected from codling moth.
				Per cent.	*Per cent.*	*Per cent.*
Bentonville, Ark	4	Ben Davis	6	11.6	88.4	50.9
	4	do	None.	62.5	37.5	
Fordland, Mo	4	Gano	7	1.8	98.2	44.1
	2	do	None.	46.9	54.1	
	3	Ben Davis	7	9.5	90.5	61.4
	3	do	None.	70.9	29.1	
	6	Jonathan	7	4.2	95.8	32.4
	6	do	None.	36.6	63.4	
Afton, Va	5	Albemarle pippin	3	5.30	94.70	72.19
	5	do	None.	77.49	22.51	
	5	Winesap	3	6.50	94.50	72.21
	5	do	None.	77.71	22.29	
Owensville, Ohio	5	Ben Davis	4	5.28	94.72	48.34
	5	do	None.	51.62	46.38	
Mount Pisgah, Ohio	5	do	4	0.92	99.08	40.71
	5	do	None.	41.63	58.37	
North East, Pa	3	Baldwin	3	4.22	95.78	68.67
	3	do	None.	72.89	27.11	

In figures 1 and 2 of Plate LV are shown the crops from a sprayed and an unsprayed tree of the Ben Davis variety. Of the unsprayed tree 41.8 per cent of the yield was free from codling moth, while on the sprayed tree the sound fruit amounted to 93.5 per cent.

DUST SPRAYING.

The practice of applying an arsenical with a fungicide, as powdered bluestone and lime in the form of a fine dust, blowing it into the trees with an air-blast machine, has been followed to a limited extent, especially in portions of the Middle West. It is claimed by the advocates of this method that results are practically equal to those obtained with liquid sprays. Careful experiments have been made by Prof. C. P. Close[a] and by Prof. C. S. Crandall[b] to determine the relative merits of dust and liquid spraying. According to the former dust sprays are not effective against apple scab, and there was an advantage in favor of liquid sprays of 1 to 3 per cent more fruit free from worms. According to Crandall dust spraying is considerably less efficient against insects than is the liquid method of applying arsenites and is absolutely ineffective in controlling fungous diseases. Although dust spraying is much cheaper than liquid spraying its smaller effectiveness for the codling moth and its practical worthlessness for fungous diseases are sufficient reasons for continuing the use of liquid sprays, especially where combination treatments for diseases and insects are practiced. On steep ground, where a spray pump may not be used or where no water supply can be provided, dust spraying will prove of value.

[a] Bul. 72, Del. College Agric. Exp. Station (1906).
[b] Bul. 106, Illinois Agric. Exp. Station (1906).

BANDING THE TREES.

As already stated, many of the larvæ make their cocoons along the trunk and limbs of the tree in protected places, as in cracks, under bark scales, etc. They will congregate in large numbers under objects leaning against the tree or under pieces of cloth or other material, and the banding system has for its object the providing of suitable places for the larvæ to spin up, the bands being regularly examined and the insects destroyed when found; otherwise the bands become a positive aid to the insects. More larvæ will be forced to the bands if the trunk and limbs of the tree are kept smooth and large cracks and holes are stopped up. A suitable band is one made of burlap, 10 to 14 inches wide and long enough to go around the tree more than once. The cloth is folded once lengthwise and wrapped around the trunk, the free end to be held down by a nail driven lightly into the tree which can be easily removed at times of examination. Bands should be examined every ten days to insure that no moths develop and escape, and should be in place on the trees about five or six weeks after the petals fall and remain until picking time of the fruit. Insects found under the bands are best killed by crushing or cutting in two with a knife. The practice of collecting all of the bands and hauling them to a central place where they are run through a wringer or placed in hot water has the disadvantage of allowing the escape of many larvæ en route. Banding, while an important adjunct to spraying, can not replace it; thorough spraying, in fact, should render banding entirely unnecessary. For home orchards of large trees which can not be well sprayed banding will be found especially useful.

GATHERING FALLEN FRUIT.

As has been stated, only a very small percentage of the larvæ fall to the ground with the fruit, and the practice of gathering and destroying fallen fruit, frequently recommended, has but little value for the codling moth; nevertheless it is advisable, especially in regions infested with the apple maggot (*Rhagoletis pomonella* Walsh), as it constitutes the most important method of controlling the latter.

SCREENING CELLARS AND STORAGE HOUSES.

A large number of larvæ are taken with the fruit in the fall to cellars, storage houses, cider factories, etc., where they later spin up in cracks in the floor and walls, under trash, and wherever suitable protection is found. Here they hibernate until spring, when moths appear and ordinarily make their escape to near-by orchards, constituting an important source of infestation. The simple expedient of screening doors and windows of houses or rooms where apples are stored will in a great measure eliminate this source of infestation by preventing the escape of the moths.

DRY-LAND FARMING IN THE GREAT PLAINS AREA.

By E. C. CHILCOTT,

Agriculturist in Charge of Dry-Land Agriculture Investigations.

INTRODUCTION.

There is perhaps no phase in the agricultural development of the United States which has attracted more attention during the past year nor any which may have greater importance to the Nation as a whole than the problem of the best utilization of the semiarid lands of the western United States.

Several conditions have contributed to the general interest in dry-land farming. The people of the United States have become aware that Government lands suitable for ordinary agriculture are almost a thing of the past. With our rapidly increasing population it will soon become necessary to utilize for crop production a large area of the rich arable land of the West which has insufficient rainfall for ordinary agriculture. Then, also, during the last two or three years there has been rather more than the average amount of rainfall over the larger part of the semiarid region, and many people acquainted with present conditions firmly believe that the climate of this region is rapidly becoming more humid. This belief is without foundation in fact and it is surprising that it should exist, for the precipitation records for the whole country are given wide publicity; but since this idea is generally held and has become widely advertised it becomes important to emphasize the fact that there is no adequate basis for hoping that the climate of the arid West is undergoing any appreciable change as regards precipitation.

Within recent years investigation and experimentation have been directed toward solving some of the complicated problems involved in the conservation of soil moisture in these arid regions. Actual additions to existing knowledge of the subject have been relatively few, but public attention has been directed to the work until the idea prevails that much is now possible in the way of utilizing a limited rainfall which was never possible before. There is some foundation for such a conclusion, but nothing to warrant the many exaggerated statements which are now current.

The conquest of the semiarid West, to be successful and to be accomplished without large and costly failures, must be made slowly

and by the careful application of definitely ascertained scientific facts. The boundaries of existing settlements may be gradually extended, but any wholesale attempts to colonize large areas of this semiarid land with people accustomed to farming only in humid regions or not accustomed to farming at all must surely result in disastrous failure, and such failures can only hinder the real progress of western development. When this development can proceed gradually from already established agricultural centers, instead of by unsupported beginnings in the midst of dry land, ultimate success is possible without any great risk of complete failure. Even where it is possible by the use of windmills or the development of springs or small streams to irrigate gardens and even small parts of fields during protracted periods of drought, the settler may be able to tide over times when, without such resources, complete failure must be inevitable.

TWO DISTINCT AREAS RECOGNIZED.

In considering the development of dry-land agriculture west of the ninety-eighth meridian, it is desirable to recognize two distinct areas, each of which has its peculiarities of climate and soil. One of these, known as the Great Plains area, includes that portion of the country lying between the ninety-eighth meridian on the east and the Rocky Mountains on the west, the thirty-second parallel of latitude on the south, and the Canadian boundary on the north; and the other, known as the intermountain area, extending from the Rocky Mountains westward to the Pacific Ocean. This article is confined to a discussion of the Great Plains area.

BOUNDARIES OF THE GREAT PLAINS AREA.

THE EASTERN BOUNDARY.—The eastern boundary, that is, the ninety-eighth meridian, is in a general way a dividing line in the States of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and the Panhandle of Texas, to the east of which agriculture has already been established on a firm and stable basis, while to the west many of the agricultural problems are still in an unsolved condition.

THE WESTERN BOUNDARY.—The western boundary of the area, that is, a contour line east of the Rocky Mountains marking an altitude of 5,000 feet, is drawn through what until very recently has been considered a range country and not an agricultural country in the ordinary meaning of the term. While there are many isolated areas of considerable extent lying west of this line in which agriculture without irrigation can be successfully practiced, the continuity of these areas is so broken and the soil and climatic conditions are so

different that they constitute essentially different problems from those of the Great Plains area, and should therefore be treated separately. It is hoped, however, that many of the facts established by the work in the Great Plains area will be of value in pointing the way toward solving the problems to be met with in these dry-land areas farther west. It is also probable that there are districts of considerable extent within the Great Plains area that by reason of altitude, topographical features, or character of soil will not be available for general agriculture; but we believe that this line—the 5,000-foot contour line—comes nearer than any other line that could be selected to being a dividing line between the area in which general agricultural development is possible and that portion of the country where dry-land agriculture can be carried on in isolated areas only.

FIG. 47.—Topographic map of the Great Plains area.

THE SOUTHERN BOUNDARY.—Our reason for bounding the area on the south by the thirty-second parallel of latitude is that this line corresponds very nearly to the southern limit of what is known as the Staked Plains. South of this line the surface of the country slopes rapidly toward the Gulf and the Rio Grande. With decreasing altitude come changes of climatic conditions, as well as changes of soil conditions, that make the agricultural problems of

the southwestern portion entirely different from those of the Panhandle of Texas and of the Great Plains area in general.

IMPORTANCE OF THE AREA AS A FIELD FOR INVESTIGATION.

Somewhere, then, within the bounds of the Great Plains area will ultimately be drawn the line which shall represent the western boundary of the great agricultural region known as the Mississippi Valley. Beyond this will be detached areas, but this will be the margin of the continuous area. It is therefore within this Great Plains area that most of the great problems of dry-land agriculture must be solved. It is here that the experiments must be carried on which shall determine what are the best methods of agriculture for the conservation of moisture and the maintenance of the fertility of the soil under climatic conditions which exist nowhere else in the United States. Experiments must here be conducted that shall determine what portions can be used for general dry-land agriculture and what portions are unfitted for that purpose. And when it has been demonstrated that certain portions of the area are unsuited to general dry-land agriculture it must be determined how these portions can best be utilized for stock raising, and where this industry becomes the predominating one means must be devised for supplementing the natural grasses of the range with forage plants, either annual or perennial. Cultivated grains imported from foreign countries having a similar climate must here be tested and selected; here also must be carried on extensive experiments in breeding agricultural plants along the lines that will adapt them to the peculiar conditions of soil and climate which here prevail.

CLIMATE OF THE AREA AND ITS EFFECT UPON SOIL CONDITIONS.

AN AREA OF LIGHT RAINFALL.

From our studies of the climatology of this area we are warranted in stating that this area has been for many hundreds of years, and is likely to remain, an area of light rainfall. Its climate is semiarid and in all probability will remain so for a time sufficiently long to warrant the assumption that for all practical purposes the average climate is constant and unchangeable. This condition of semiaridity is by no means an unmixed evil. It is probably due to this that the soils of this area are of such wonderful fertility.

CAUSE OF GREAT SOIL FERTILITY.

While the scanty rainfall has not tended to produce a particularly luxuriant growth of vegetation during past ages it has served to preserve within the soil the products of decomposition of such vegetation as has been produced. It has also assisted in the production of large quantities of those chemical salts upon which plants depend for their

nourishment, and the evaporation being in excess of the precipitation the tendency has been to keep these beneficial salts near the surface instead of having them either carried far below the reach of the plant roots by seepage or removed by the excess of water which occurs in more humid countries. A country having just sufficient rainfall to furnish moisture for growing crops at the time when these crops need it and with only sufficient moisture during other months of the year to keep the soil in good physical condition has ideal conditions so far as precipitation is concerned. There is no doubt that during the most favorable seasons these conditions do actually prevail throughout a large portion of the Great Plains area. It is true, of course, that this perfect adjustment between the actual precipitation and the needs of the plants is too seldom realized, but in nearly all parts of the area it is often closely approached.

CHANGE OF CLIMATE A FALLACY.

It is the frequent observance of these especially favorable conditions during past years that has led people to believe that the climatic conditions were actually changing and that in time the climate would reach a stable condition fairly approximating the very favorable conditions that have sometimes prevailed. While such a pleasing hope may in some instances serve as a stimulus to action, in many other cases it will serve to encourage people in entertaining hopes that will never be realized. The only safe rule when considering climatic conditions in this or any other area is that "what has been will be" so far as climatic conditions are concerned. If destructive and devastating droughts have occurred in the past in any given area it is probable that they will recur in the future; but it does not necessarily follow, nor do we believe it is true, that the results from these droughts will be as destructive in the future as they have been in the past.

IMPROVED METHODS AND PRACTICES.

Already methods have been devised and are in practice throughout the area whereby the moisture of the soil can be conserved and crops may be raised under conditions of drought that have in the past proved absolutely prohibitive of agricultural production. The introduction and development of drought-resistant plants is now enabling farmers in many parts of the area to produce crops of grain during years of drought so severe that it would be impossible to raise any of the grains that were originally introduced into the area from the more humid parts of the country. This development of cultural methods, crop rotations, plant adaptation, and farm organization is only just begun, and in time there will be no part of this area that will not be producing much more than at the present time. We believe that if the experiments already begun by the Office of Dry-

Land Agriculture Investigations, together with the natural development of this work, can be carried on continuously for a long term of years they will aid materially in the solution of many of the problems of dry-land agriculture which are so urgently demanding attention.

COOPERATIVE WORK WITH STATE EXPERIMENT STATIONS.

Throughout this vast area of nearly 400,000 square miles there is not a single State agricultural experiment station, although there are substations at Judith Basin, Mont., Dickinson and Edgeley, N. Dak., Highmore, S. Dak., North Platte, Nebr., and Garden City and Hays, Kans. Cooperative work between the Department of Agriculture and the State stations has already been commenced at all these points, and independent stations have been established at Bellefourche, S. Dak., Amarillo and Dalhart, Tex., and Akron, Colo. Other stations will soon be established in Colorado, Wyoming, Montana, and Oklahoma. (Fig. 48.)

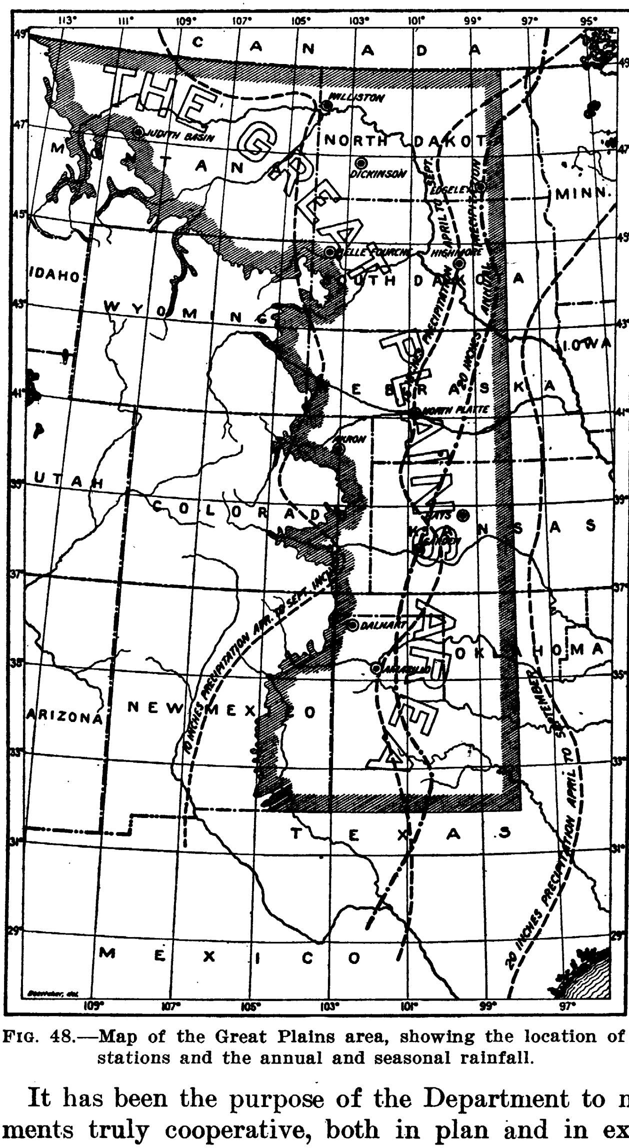


FIG. 48.—Map of the Great Plains area, showing the location of stations and the annual and seasonal rainfall.

It has been the purpose of the Department to make these experiments truly cooperative, both in plan and in execution. A large

part of the time of the Department's representative who is in charge of this work is devoted to visiting the various substations and their parent State experiment stations and in consulting with the men most interested in the development of this line of work. It is desired to bring together the very best ideas and practices of these men and work them out into a system of cooperation that will be of great benefit not only to the Department but to each of the cooperating stations and ultimately to the farmers of this entire area. The actual practical experience of the men who have been in close touch with these problems in the field has been made the basis of the work, and it is earnestly desired that every practical man connected with the stations in all these States contribute his share in working out these important problems.

From the very nature of the proposed work it must necessarily extend over a long term of years. Therefore, while no representative of the Department can enter into any agreement that will be binding for more than one year in advance, it has been generally understood both by the Department and the State experiment stations that unless there was reasonable probability that this work could be continued uninterruptedly and for a long term of years it would not be undertaken. The results of a single year's work, or in fact two or three years' work, would be of very little value as compared with the results of ten or twenty years. The value of the work increases in geometrical rather than in arithmetical proportion to the time involved; hence the desirability of planning for its long and uninterrupted continuance.

EXPERIMENTS IN SOIL PREPARATION.

The purpose of this series of experiments is to ascertain as nearly as may be what system of cultivation will best conserve the soil moisture for the uses of the growing crop.

THE PROBLEMS TO BE SOLVED.

There are many problems in connection with the growing of crops in the semiarid districts that are of great importance and should be solved, if possible, without unnecessary delay, but experience has shown that better results are obtained when experiments are so planned as to involve as few variable factors as possible and when all effort is centered upon a few general principles rather than upon many subsidiary problems. It is for this reason that these experiments have been made as simple and elementary as possible. The questions they are planned to answer are: "How can the largest average yield of the four staple crops—corn, wheat, oats, and barley—through a long series of years be obtained: (1) by raising the same

crop continuously by ordinary methods of culture now in practice; (2) by continuous cropping with the same crop, using the most approved methods of cultivation for moisture conservation; or (3) by alternate cropping and summer fallowing by the most approved methods?"

When satisfactory answers can be given to these questions we shall be ready to give attention to some subsidiary questions, such as the limits to the amount of labor that can profitably be expended upon the soil in order to conserve the soil moisture, the length of time that can intervene between summer fallows where summer fallowing is found desirable, the substitution of some cultivated crop like corn for summer fallow, and the proper sequence in which the several crops should occur when grown in rotation. But until these fundamental questions can be answered there is little hope of answering the subsidiary questions. Some of them will be answered by the experiments in crop rotation about to be described, but many of them are of such a local character, so dependent upon peculiarities of soil, climate, and economic relations, that they can not be attempted in a scheme of so general a nature as the one under consideration, but must be worked out for each locality and in many instances for each farm.

PLAN OF THE EXPERIMENTS.

Under this plan it will be possible to carry on the general experiments outlined herewith simultaneously at 15 points located in Texas, Oklahoma, Kansas, Colorado, Nebraska, North Dakota, South Dakota, Wyoming, and Montana, which will greatly increase the value of the work at each of these points in establishing some general principles that will apply not only to one locality or one State, or to a single season, but to the whole semiarid district and to average conditions for a long term of years. The accompanying outlines will give an idea of the general plan of these experiments.

Outline of plan for experiments with four staple cereal crops with ordinary methods of culture and with moisture-conserving methods, each crop to be grown on the same plat for several years, either continuously or alternating with summer fallow.

Experiments with corn:

Plat A. Corn grown year after year on spring-plowed land by ordinary methods of culture.

Plat B. Corn grown year after year on fall-plowed land by moisture-conserving methods of culture.

Plat C. Corn alternating with summer fallow.

Plat D. Summer fallow alternating with corn.

Experiments with wheat:

Plat A. Wheat grown year after year on spring-plowed land by ordinary methods of culture.

Experiments with wheat—Continued.

Plat B. Wheat grown year after year on fall-plowed land by moisture-conserving methods of culture.

Plat C. Wheat alternating with summer fallow.

Plat D. Summer fallow alternating with wheat.

Experiments with oats:

Plat A. Oats grown year after year on spring-plowed land by ordinary methods of culture.

Plat B. Oats grown year after year on fall-plowed land by moisture-conserving methods of culture.

Plat C. Oats alternating with summer fallow.

Plat D. Summer fallow alternating with oats.

Experiments with barley:

Plat A. Barley grown year after year on spring-plowed land by ordinary methods of culture.

Plat B. Barley grown year after year on fall-plowed ground with moisture-conserving methods of culture.

Plat C. Barley alternating with summer fallow.

Plat D. Summer fallow alternating with barley.

EXPERIMENTS WITH CROP ROTATIONS.

There are few if any problems in farm management greater than that of crop rotation. The importance of the problem has been recognized in the older portions of this country for many years, but it is only recently that it has been given any attention in the West. Some have even claimed that it is not of so great importance there as in the East. Far from such being the case it is probably of even greater importance where the subject of moisture conservation is an important one than in humid districts. Very little carefully planned and systematically executed experimental work in crop rotation has been carried on in this country, and none of so comprehensive a scope as is herein proposed.

In these experiments, as in those already outlined, the effort will be made to get at general principles rather than to solve specific local problems. In order to reduce the number of variable factors as much as possible it has been considered desirable to confine these experiments to rotations of uniform length, and after careful consideration a three-year rotation has been decided upon as the best for the purpose of this experiment, although probably not the best for general farm practice. In the selection of crops it has been considered desirable to confine our work to the four staple crops grown in this district—corn, wheat, oats, and barley—for these are the only crops that are grown extensively throughout the entire district extending from the Panhandle of Texas on the south to the Canadian boundary on the north.

Wherever grass and clover can be raised they should enter into any system of rotation adapted to that locality. But in some localities within this district the growing of grass and clover is so precarious

that it would not be safe to count upon it in such an experiment as is here contemplated. Then, again, the plowing under of sod of any kind so modifies the physical conditions of the soil that it is likely to obscure the results of the other more general and therefore more important factors.

The two important questions that these experiments are planned to answer are: (1) What is the best sequence for the four staple crops and (2) how should the ground be prepared to obtain the best results in those districts where the conservation of soil moisture is the all-important problem?

It is believed that by confining these cooperative experiments to these general principles and at the same time encouraging each local cooperator to establish other rotations to be considered under the same general plan as the cooperative work but dealing with local problems, better results will be obtained than by attempting to enlarge the scope of the strictly cooperative work, at least until experience has shown the desirability of such enlargement.

THREE-YEAR ROTATIONS.

Comparison of various three-year rotations for study of general principles.

Rotation No. 1.
- Plat A. Spring wheat on corn ground disked but not plowed.
- Plat B. Oats on ground plowed early the preceding fall.
- Plat C. Corn on ground plowed early the preceding fall.

Rotation No. 2.
- Plat A. Spring wheat on spring-plowed ground.
- Plat B. Oats on spring-plowed ground.
- Plat C. Corn on spring-plowed ground.

Rotation No. 3.
- Plat A. Spring wheat on ground plowed early the preceding fall.
- Plat B. Oats on ground plowed early the preceding fall.
- Plat C. Corn on ground plowed early the preceding fall.

Rotation No. 4.
- Plat A. Oats on corn ground not plowed but disked.
- Plat B. Spring wheat on fall-plowed ground.
- Plat C. Corn on fall-plowed ground.

Rotation No. 5.
- Plat A. Spring wheat on fallow land.
- Plat B. Oats on ground plowed early the preceding fall.
- Plat C. Summer fallow.

Rotation No. 6.
- Plat A. Barley on corn ground not plowed but disked.
- Plat B. Oats on ground plowed early the preceding fall.
- Plat C. Corn on ground plowed early the preceding fall.

Rotation No. 7.
- Plat A. Oats on spring-plowed ground.
- Plat B. Barley on spring-plowed ground.
- Plat C. Corn on spring-plowed ground.

Rotation No. 8.

Plat A. Oats on fallow land.
Plat B. Spring wheat on ground plowed early the preceding fall.
Plat C. Summer fallow.

Rotation No. 9.

Plat A. Oats on spring-plowed ground.
Plat B. Spring wheat on spring-plowed ground.
Plat C. Corn on spring-plowed ground.

These nine 3-year rotations are so planned as to give an opportunity to compare the several rotations considered as units and also to compare the several crops grown in different rotations under systems of soil preparation and following different crops. As each rotation is represented by three plats, each of the crops entering into the rotation is represented every year. This is a very important feature and one that has been neglected in most of the rotation experiments heretofore made. By this system the difference in yield produced by the seasonal peculiarities is eliminated, and we may safely assume that any difference in yield that occurs in any two crops of the same kind grown the same year in two rotations is due either to the method of soil preparation or to crop sequence. Which of these two factors is the controlling one may usually be determined by an easy system of cross checking with the same crop in other rotations, whereby one or both factors may be eliminated.

CROP ROTATIONS FOR THE CONSERVATION OF HUMUS.

As already explained, it seems to be necessary to omit from these experiments all rotations that contain a grass crop or any other crop that will affect the physical condition of the soil by adding organic matter to it. Now, while it is recognized that such omission is necessary for the purposes of these experiments, it is also recognized that any such system as herein outlined must be very destructive of the humus in the soil and that in time this depletion of humus must have a bad physical as well as chemical effect. In order to determine just how great this bad effect will be it is highly desirable that other experiments in crop rotation calculated to restore or at least conserve the organic matter in the soil be carried on at the same time. About 60 plats, representing about 11 rotations at each of the substations thus far established, have therefore been devoted to this problem of humus conservation. The 9 rotations here specified are already established at most of the substations. These 9 rotations require 40 plats. About 20 additional plats, representing 4 or 5 rotations, are established at most of the substations. These rotations can be still further modified so as to adapt them to local conditions and to include the ideas of local men.

Crop rotations for the conservation of humus.

Rotation No. 10.

Plat A. Corn on spring-plowed ground.

Plat B. Wheat on corn ground disked but not plowed, seeded to brome-grass.

Plat C. Brome-grass meadow.

Plat D. Brome-grass meadow.

Plat E. Oats on backsetting of sod broken the preceding summer.

Rotation No. 11.

Plat A. Corn on spring-plowed ground.

Plat B. Wheat on corn ground disked but not plowed.

Plat C. Clover sown without nurse crop in June on fall-plowed ground.

Plat D. Clover meadow.

Plat E. Oats on backsetting of sod broken the preceding summer.

Rotation No. 12.

Plat A. Corn on spring-plowed ground.

Plat B. Wheat on corn ground not plowed but disked, seeded to brome-grass.

Plat C. Brome-grass meadow.

Plat D. Brome-grass meadow.

Plat E. Flax on brome-grass sod broken just before seeding.

Plat F. Oats on fall-plowed ground.

Rotation No. 14.

Plat A. Corn on spring-plowed ground.

Plat B. Wheat on corn ground not plowed but disked.

Plat C. Rye turned under for green manure.

Plat D. Oats on ground kept thoroughly dragged since rye was turned under.

Rotation No. 15.

Plat A. Corn on spring-plowed ground.

Plat B. Oats on corn ground not plowed but disked.

Plat C. Rye turned under for green manure.

Plat D. Oats on ground kept thoroughly dragged since rye was turned under.

Rotation No. 16.

Plat A. Corn on spring-plowed ground.

Plat B. Wheat on corn ground not plowed but disked.

Plat C. Peas turned under for green manure.

Plat D. Oats on land kept thoroughly dragged since peas were turned under.

Rotation No. 17.

Plat A. Corn on spring plowing.

Plat B. Oats on corn ground disked but not plowed.

Plat C. Peas turned under for green manure.

Plat D. Wheat on land kept thoroughly dragged since peas were turned under.

Rotation No. 18.

Plat A. Oats on corn ground not plowed but disked.

Plat B. Summer fallow.

Plat C. Wheat on fallow ground.

Plat D. Corn on spring-plowed ground.

Rotation No. 19.

Plat A. Wheat on corn ground not plowed but disked.

Plat B. Summer fallow.

Plat C. Oats on fallow ground.

Plat D. Corn on spring-plowed ground.

It is believed that these rotations are adapted to the Dakotas, Montana, and Wyoming, and with only slight modifications to Nebraska and Colorado. For Kansas, Oklahoma, and Texas substitutions have been made. Kafir corn has been substituted for corn and soy beans or cowpeas for Canada field peas or black-eyed marrowfat. Winter rye and winter wheat are raised in the South and spring wheat and spring rye in the North. In the South, where flax can not be profitably raised, some southern crop has been substituted for it. Where brome-grass or clover can not be raised some substitution has been made. Any or all of these suggested substitutions may be made without breaking up the general plan of the rotations, and the results obtained will be comparable with the rotations in the general plan.

Some of these rotations may seem impractical for general farm practice, but that does not necessarily make them less desirable for the purpose of these experiments. What we want to determine is the relation between methods and results.

SUBSTATIONS AFFORD A FIELD FOR OTHER LINES OF INVESTIGATION.

In addition to the strictly agricultural investigations briefly described, these substations afford a field for many other lines of investigation. For instance, Dr. L. J. Briggs, physicist of the Bureau of Plant Industry, is carrying on an extensive line of investigations at these substations to determine as far as may be the physical factors entering into the problem of crop production under semiarid conditions. Mr. W. M. Jardine, assistant cerealist, is investigating the problem of breeding drought-resisting cereals. Mr. T. H. Kearney, physiologist, is investigating the resistance of forage crops to alkali and to drought. Dr. K. F. Kellerman, bacteriologist, is investigating soil bacteriology in relation to crop rotations and methods of cultivation. Several other lines of investigation are also being carried on, and the results of all will enter into the solution of the various problems of dry-land agriculture.

The success of dry farming as it is now practiced in the semiarid districts of the Great Plains area depends upon the application in the most thorough manner of the principles of tillage which have been practiced to a greater or less extent for several hundred years.

MISTAKES OF SETTLERS IN THE GREAT PLAINS AREA.

Settlers who came to the more humid portions of the trans-Mississippi region soon discovered that with the fertile and easily tilled soils and abundant rainfall of these districts it was possible to produce crops successfully with much less labor than is usually bestowed upon them in the less-favored portions of the East. This led to very superficial and slovenly methods of tillage. Plowing was frequently

not only very carelessly done and to a depth of only 3 or 4 inches, but in some instances the land was plowed only once in three or four years, and sometimes even a much longer period was allowed to elapse between plowings, the grain being "stubbled in" upon the unplowed stubble of the previous year's crop. Where the land was not plowed it was usually prepared for seeding with a disk harrow. While this system of farming brought fairly successful returns during favorable years for a time after the virgin prairie was broken, it became less and less remunerative as the soil became exhausted of organic matter, and the farmers learned by costly experience that even in the more humid portions of the Great Plains some other system of tillage would be necessary in order to maintain the fertility of their farms.

As settlements extended westward into the drier districts the same shiftless methods were used as those at first practiced farther east. A series of dry years which culminated in the disastrous drought of 1894 not only demonstrated that these methods were unprofitable where the problem of moisture conservation was most important, but it actually served to depopulate a considerable part of the more arid portions of the Great Plains area. Many farmers abandoned their farms, which were sold for taxes and finally fell into the hands of large land companies.

INCREASE IN PRECIPITATION ONLY TEMPORARY.

Since 1894 there has been a somewhat regular increase in the annual precipitation throughout the Great Plains area, until in 1905 it reached the highest point recorded by the Weather Bureau, but only very slightly in excess of the precipitation of 1883. This increase in precipitation, which made the agricultural conditions more favorable, together with the demand for cheap farm lands, had the effect of causing these large land companies to exploit what is now generally known as "dry farming."

BETTER METHODS OF FARMING.

Many of the settlers had learned by bitter experience that it would be necessary to adopt even more thorough methods of tillage here than had been required in the more humid East. No new discoveries had been made as to the principles or practices of thorough tillage, but it had been learned that thorough tillage was necessary. It has long been known that the loss of moisture from a stubble field left bare by harvesting the crop is greater than at any other time. This is particularly true in the semiarid districts, where the temperature and wind velocity are usually very high at this time of year. In order to avoid this loss of moisture, it is desirable to plow the land as soon as possible after the crop is removed.

PROMOTING STORAGE OF MOISTURE IN THE SOIL.

Where the annual precipitation is only barely sufficient for the crop it is of the greatest importance that the soil be kept in such condition that it will be able to store as large a proportion of the rain that falls as possible. It is therefore evident that plowing should not only be done as early as is possible in the fall or late summer, but the plowing should be deep enough to afford a reservoir to receive the rains that fall during the autumn and winter following.

PACKING THE SOIL.

If the land is plowed during hot, dry summer weather and is allowed to lie loosely as it is left by the plow there will be a great loss of moisture by evaporation. It is therefore necessary to thoroughly compact the soil as soon as possible after plowing. This can be done in various ways. Thorough harrowing with an ordinary harrow will accomplish the result in some cases and upon some soils. An implement known as a subsurface packer has been found very effectual for this purpose. This implement is simply a gang of wheels with V-shaped rims running about 6 inches apart upon a common shaft. The common disk harrow, with disks set nearly straight, is sometimes used for this purpose. Any implement will serve the purpose that will pack the soil but leave the surface somewhat loose.

HARROWING BEFORE SEEDING.

If rains occur after the plowing and packing have been done they will form a crust upon the surface and the evaporation from the soil will be greatly increased. It is therefore advisable to harrow the surface with a light harrow after every rain that occurs during the fall and in the southern portion of the area in the winter. In the spring the soil should be thoroughly harrowed until seeded.

IMPORTANCE OF LIGHT SEEDING.

Seeding of small grains should be much lighter in the arid districts than in the humid districts. It would be impossible to state the proper quantity of seed to use to the acre, as this will be governed largely by locality. It is probable that as little as one-half bushel of wheat per acre can be profitably used in the drier portions.

HARROWING AFTER SEEDING.

After the seeding has been done in the spring the land should be harrowed after every rain until the grain has reached the height of 3 or 4 inches. This will tend to conserve the moisture and will also destroy many weeds. The seeding should be done with some kind

of a drill that will distribute the seed evenly and deeply and pack the soil around it thoroughly. Various types of press drills are upon the market, nearly all of which give satisfaction. Where fall grain is raised instead of spring grain seeding should be done in the fall instead of in the spring, but with this difference—the treatment of the soil should be the same as for spring seeding, as previously described.

SUMMER FALLOW OF DOUBTFUL UTILITY.

The practice of alternate cropping and summer fallowing is a common one in the semiarid region. Where this is done the land is kept thoroughly tilled during the year of summer fallow so as to store up the moisture of two years for the use of one crop. The value of this practice of allowing the soil to remain bare during the entire season is questionable, for, though it may serve to give good results for a few years, it must necessarily result in an almost complete destruction of the organic matter in the soil. This will bring about such a physical condition of the soil that it will no longer retain moisture as it did when it contained an abundant supply of organic matter.

GREEN MANURING WITH SUMMER TILLAGE A BETTER PRACTICE.

A much better practice is to raise some kind of a leguminous crop which can be turned under before it becomes hard and woody and while there is still a sufficient amount of moisture in the plants and in the soil to cause rapid decomposition. The physical as well as the chemical composition of the soil will be improved by this practice instead of injured, as is the case where bare summer tillage is practiced.

DROUGHT-RESISTANT CROPS IMPORTANT.

The introduction and development of drought-resistant crops has done much to extend the agricultural area in the semiarid districts. Durum wheat, Kherson or Sixty-Day oats, and various strains of kafir and milo belong to this class of crops.

STATUS AND NEEDS OF DRY FARMING IN THE GREAT PLAINS AREA.

It will therefore be seen that dry farming depends upon the utilization of what has long been known but insufficiently practiced, rather than upon any new discoveries; upon the adaptation of well-known means to a definite end, rather than upon the establishment of any new system. It is the return to time-tested methods of intensive cultivation for the purpose of moisture conservation in place of the shiftless and superficial methods of extensive farming which sprang up upon the rich and easily tilled prairies of the subhumid belt.

DRY FARMING STILL IN THE EXPERIMENTAL STAGE.

How successful these intensive methods will be in overcoming the effects of severe and long-continued drought remains yet to be determined. As before stated, the exploiting of dry farming on the Great Plains has been carried on during a period of unusually heavy rainfall. In all probability droughts as severe and as long continued will occur in the future as have occurred in the past. Then, and not until then, will these methods be subjected to the decisive test. Undoubtedly the area that can be brought under successful agriculture may be greatly extended by the methods now being tried, but this extension will unquestionably be greatly influenced by many factors, such as local peculiarities of soil and climate, which are at present almost unknown or at least little understood, and it would be exceedingly presumptuous for anyone to attempt to set any definite limit to the area that can be successfully dry farmed.

DRY FARMING REQUIRES CAPITAL.

Many expensive failures will undoubtedly be made before it will be definitely settled what lands can and what can not be profitably farmed, and it is to be hoped that these experiments may be made by men of capital rather than by poor settlers to whom one or two crop failures mean utter ruin. It is even doubtful whether there will ever be a sharp line of demarcation between the strictly agricultural and the range districts. It is much more probable that there will always be a borderland where stock raising will be the important industry with farming as a side issue. The actual settler who will give his personal attention to the details of farm work and who has had sufficient experience in farming under somewhat similar conditions to make him familiar with the general practices required in the semiarid districts and who has sufficient capital to buy one or two sections of land, to build a house and barn, and to stock the farm with a hundred head of cattle or more, together with the necessary teams, will have a fair chance of success where the settler who owns but a quarter section of land and has only sufficient capital to buy a team and the necessary farming implements would meet with almost certain failure. It is believed that it must be to this class of well-to-do farmers who will combine stock raising with farming that we must look for the agricultural development of a large portion of the semiarid districts.

DRY FARMING ON A LARGE SCALE.

There have recently been organized companies for the purpose of carrying on farming operations on a large scale, doing the plowing and in fact practically all of the farm operations with steam traction

engines. How successful these companies will be is not yet known, as the work is still in the experimental stage. Many conservative capitalists who have made a careful study of the problem believe this to be a promising field for investment, and it is to be hoped that these companies may meet with success, for it will mean much to the agricultural development of an immense area of very fertile land. No one should, however, enter upon this work without giving it careful consideration and recognizing the fact that many risks are involved.

THE GAME RESOURCES OF ALASKA.

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ALASKA A NATURAL GAME RESORT.

The Territory of Alaska is of vast extent and possesses a varied climate, broad rivers, innumerable lakes, deep forests, and chains of lofty mountains—in short, many of the chief attributes of a natural game resort. Its barren northern shores, frequented by the lumbering walrus and the formidable polar bear, are washed by ice-laden currents, while its southern extensions support luxuriant forests inhabited by the graceful Sitka deer. Between these extremes are great interior forests, the home of the lordly moose, broad open tundras and rolling plateaus, traversed by herds of unsuspicious caribou, and snow-clad mountain ranges, the stronghold of sharp-eyed sheep and dull-witted goats.

Among Alaska's game animals are some of the largest and finest in the world, as the giant moose and the huge brown bears. The game of the entire Territory includes moose, caribou, deer, mountain sheep, mountain goat, walrus, and polar, brown, grizzly, black, and glacier bears, besides a variety of waterfowl, shore birds, and upland game birds. In game resources Alaska compares favorably with the western part of the United States in early days, and at the present time it is one of the most important game regions in the world.

VALUE OF ALASKA'S GAME.

Without entering into the general subject of the value of game to all countries possessing it, Alaska's game may be considered chiefly with reference to the features making it especially valuable.

Alaska is of particular importance as a game region because, of all American possessions, it is the one in which frontier conditions promise to last longest. Notwithstanding its wealth of mineral and other resources the Territory is not likely to be thickly populated, at least not for decades to come. It is true railroads already are beginning to penetrate its wilds and no doubt cities of considerable size will develop, but, even so, immense tracts far from populous centers will long remain in almost primeval condition. This is apparent from the great size of the Territory and its climatic and

physiographic conditions. Its area is almost one-fifth that of the entire United States, and although much of this is economically full of promise it must not be forgotten that nearly one-fourth lies beyond the Arctic Circle and that a large proportion of the remainder consists of high mountains and inhospitable wilds. In the States irrigation is reclaiming many arid tracts and drainage is making it possible to utilize swamps and waste areas which now furnish refuges for game. From all parts of the country come reports of an increasing scarcity of game animals. Hence our remaining natural game preserves in Alaska are the more to be prized and correspondingly to be guarded. Within the United States certain kinds of game may be maintained for years on their original range, but for other kinds the reserve is inevitable, as no restriction of shooting can offset the constant diminution of the natural range they require. Thus most of the winter feeding grounds of the wapiti, or elk, already have been absorbed for agricultural purposes and the animals bid fair to be reduced to semidomestication, being fed like cattle in winter or confined to inclosed or restricted ranges. The same experience probably would have come to the bison, but its fate was decided more peremptorily. Very different, however, are conditions in Alaska, and, so far as can be seen at present, ample room for wild game will be available for years to come. The problem to be solved therefore relates only to saving the game itself.

Even if bison, elk, and antelope had remained abundant in the United States, still the game of Alaska would be of special interest because it includes many fine animals quite different from these in kind and in habits. The wholesome interest in nature study and outdoor life recently awakened in the United States is likely to be permanent, and future generations, whether hunters, naturalists, animal photographers, or simply lovers of nature, will set a high value upon the possession of an undespoiled territory furnishing primitive haunts for wild game.

To the permanent inhabitants of Alaska the value of game is obvious. Indeed, although much game was killed during the early rushes of gold seekers, Alaskans generally have not been slow to appreciate the necessity of game protection and the sentiment in favor of it is growing rapidly. Prospectors and travelers in the wilderness must depend largely on game for food, and their necessities have been fully recognized in the game law. Considerable game also has been killed for consumption in small settlements where no regular supply of other fresh meat is available. However this be regarded, it is evident that restrictions must be placed upon the killing of game for sale in large towns where the demand is sufficient to endanger the very existence of the species. So far no species

have been exterminated, but the traffic in wild game already is a matter of serious moment and difficult to regulate.

Besides serving as food, some of the animals are of local value for their skins, the whites having adopted many of the articles customarily used by Indians, as skin clothing, bedding, and footwear. Most Alaskans, although enjoying the sport, pursue game with utilitarian purpose, yet not a few hunt in regular season purely for the enjoyment of the outing, and by such the game is greatly valued, since it makes life more tolerable in a country where diversions are limited.

The game of Alaska has a very real money value. Each individual animal is part of a great interest-bearing capital. If all the game in Alaska were brought together in one large inclosure the animals so gathered would far outnumber those of the largest stock farm in the world. Assuming it possible to market such a herd a large sum of money would be realized. But a stock raiser does not market his entire herd unless retiring from business. He sells only the annual increase in order that the herd may maintain itself and assure an unfailing future income. Viewing the matter solely from a business standpoint a similar conservative course should be pursued with our stock of wild game, the extermination of which for the sake of immediate returns is absolutely indefensible.

In addition to its inherent value game is of great pecuniary importance to the country it inhabits on account of the money spent there by visiting sportsmen. Not only are substantial revenues derived through the direct sale of hunting licenses, but considerable sums are distributed in the payment of traveling expenses and in the employment of guides, packers, boatmen, and others. To Alaska and Alaskans such considerations are not without importance, for the development of this northern Territory will in the long run require the utilization of every resource. If lands unsuitable for mining or agriculture can, by reason of the wild game inhabiting them, be made a part of the permanent resources of the country, they have a substantial value. If properly husbanded the game becomes a perpetual source of pleasure and profit, whereas if it is ruthlessly sacrificed to immediate desires the region now made attractive by it will lapse into a comparatively uninteresting and useless waste.

Passing from general considerations, the several kinds of game resident in Alaska may be considered, with brief descriptions of the country they inhabit and a few words regarding their numbers, habits, and recent history.

MOOSE.

The Alaska moose (*Alce americanus gigas*) is the largest existing land mammal in America and the largest member of the deer family

in the world. It is similar to the moose of eastern North America and the elk of the Old World, but exceeds them in size and differs somewhat in color and cranial characters. Its antlers reach magnificent proportions, almost rivaling those of the extinct Irish elk. The average spread from tip to tip is between 5 and 6 feet, while many pairs have been recorded having a spread of more than 6 feet. (See Pl. LVI.)

Moose are generally distributed throughout the timbered parts of Alaska, except in the southeastern coast region, where they are absent. On the Alaska Peninsula they range to the limit of timber and

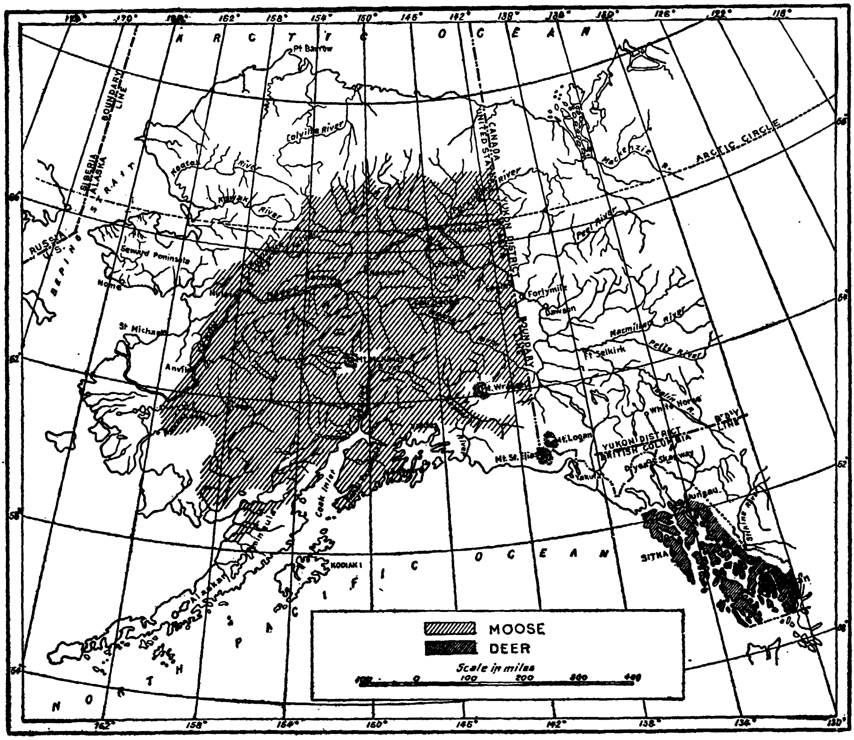


FIG. 49.—Distribution of moose and deer in Alaska.

in the north and west likewise reach the edge of the tundra. (See fig. 49.) In the mountains their tracks are so numerous on high rocky ridges above timber line that such places may well be regarded as a part of their regular range. But most of their time is spent in the mixed woods of spruce, poplar, and birch at moderate elevations or on the flats along the river bottoms where dense growths of spruce alternate with openings containing small ponds and grassy swamps bordered by thickets of willow and alder. The latter places are mostly sought during the season of flies and mosquitoes, to escape which the animals often lie for hours partly submerged in shallow ponds. In fall,

although they may not entirely desert the low country, moose resort largely to the mountain sides and the scattered groves of trees near timber line. As to their winter habits little is known, but apparently they do not "yard," or at least not to such an extent as the eastern moose. The calves are born from early May to late June and follow the cows at least until the next spring. The rutting season begins about the middle of September.

Various methods of hunting moose are employed in Alaska. Of these still hunting is most common. Calling with the birch-bark horn, so successfully practiced in eastern Canada, is not greatly in vogue, but when properly executed is effective. Contrary to the custom in the East the imitation of the bull is used most frequently, although evidence that bulls can be attracted by the call of the cow is not lacking. In some instances dogs have been successfully employed. The Indian's lazy method of lying in wait near trails or ponds known to be frequented by moose is also practiced.

Although moose occur throughout practically all the interior of Alaska and in some places near the coast they are not uniformly distributed, and certain localities are much more favored by them than others. Beyond doubt they are more numerous on the Kenai Peninsula than in any other area of equal size, and here they attain a larger size than elsewhere. They are fairly common also in certain districts near the Yukon River between Eagle and Circle, while many less-known parts of the interior are much frequented by them.

CARIBOU.

Caribou inhabit the treeless and semi-treeless parts of Alaska, including the bare mountain ridges of the interior and the open rolling tundras of the coast from the Arctic Ocean to the Pacific side of the Alaska Peninsula. Throughout this region the greenish white lichen or "reindeer moss," which constitutes their principal food, is abundant. Except in crossing from one mountain ridge to another they rarely enter the timber and consequently are seldom seen by travelers on the main river highways. They scatter widely in summer and in fall collect in herds, often very large, but at all times they roam widely. The great herds in the fall of the year perform a more or less regular movement in the nature of a migration, and within certain limits their course of travel and times of arrival at given points are well known. Probably the best known of the large herds is the one which collects along the watershed between the Yukon and Tanana rivers. This herd still regularly musters from 1,000 to 3,000 or more animals, although levied upon annually by hunters from Forty Mile, Eagle, Circle, and the new mining towns on the Tanana River. Herds perhaps equally large range the little-known Arctic slope along the

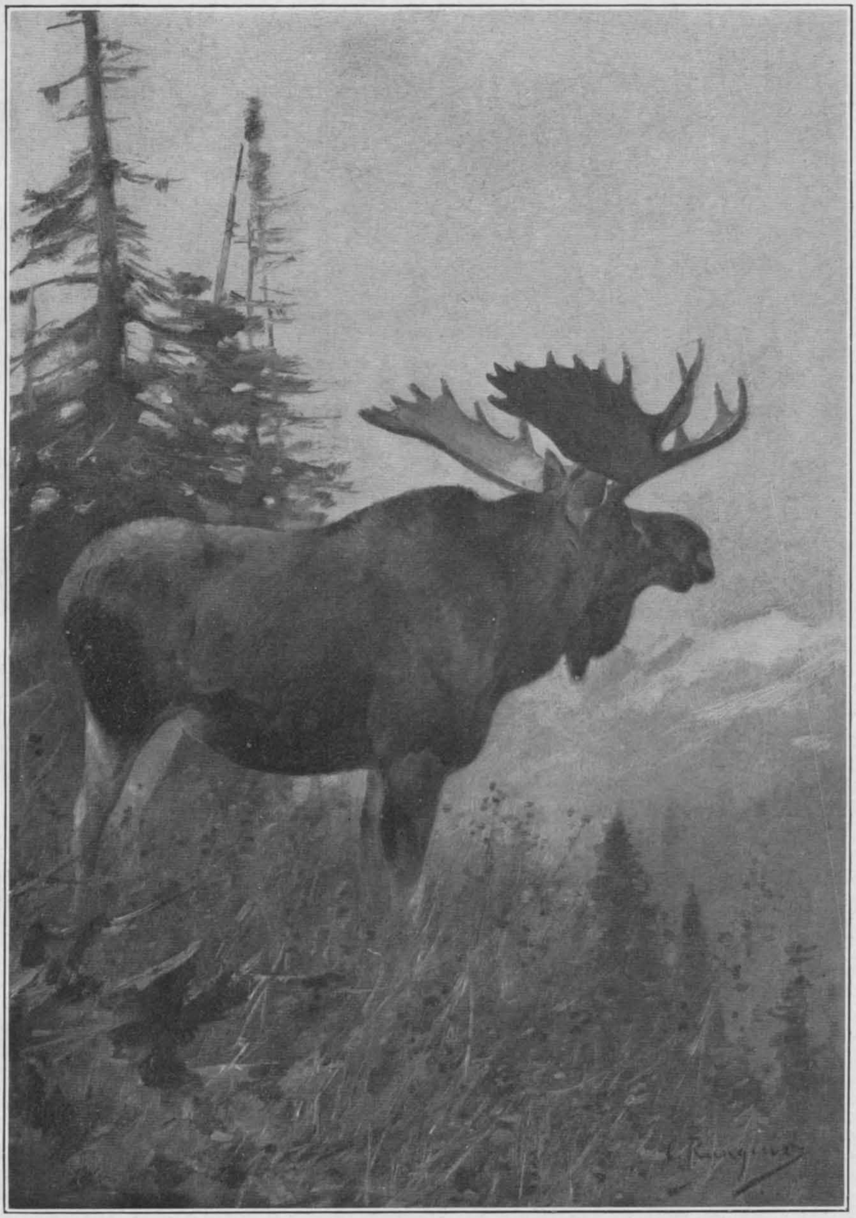
Endicott Mountains and adjoining parts of the northern Rocky Mountain system and thence to the Arctic coast, and smaller ones throughout the length of the Alaska Peninsula. Thence inland to Mount McKinley and southward along the Nutzotin Mountains to the eastern side of the St. Elias Range scattering herds are distributed. (See fig. 50.) Except on the Alaska Peninsula caribou are very scarce on the coast of Bering Sea, where formerly abundant, having been driven out or extirpated. But elsewhere their original range is so little frequented by man that they retain most of it, though probably in greatly reduced numbers. Nevertheless, with the possible exception of the walrus and the large brown bears, the caribou are in greater danger of extirpation than any of the other large animals of Alaska. Like most gregarious animals, they are easily killed in large numbers and even when found singly or in small herds display but little sagacity in eluding pursuers. Hence they fall ready victims to ruthless meat hunters and conscienceless Indians. Although chiefly living in open country they depend very little upon sight for protection, and their keenness of scent avails only slightly against hunters who know their habits. Once found it requires little skill to kill them, and although this tends to lower them in the eyes of genuine sportsmen they are still highly regarded, not only for the handsome trophies furnished by their antlers, but also on account of their interesting habits. They present especially inviting subjects for the animal photographer, but as yet no really good photographs of them have been taken.

Formerly the woodland caribou inhabited Maine and other northern States, but in recent years it has disappeared and may never reoccupy its old territory. The caribou of Alaska, therefore, are the only ones now to be found in the territory of the United States. Though belonging nominally to three species, *Rangifer arcticus*, of northern Alaska, *Rangifer granti*, of the Alaska Peninsula, and *Rangifer stonei* of the Kenai Peninsula, they differ from each other only slightly. They are essentially barren-ground caribou, though the last (*stonei*) is somewhat larger than the others and shows some resemblances to the large mountain caribou of British Columbia.

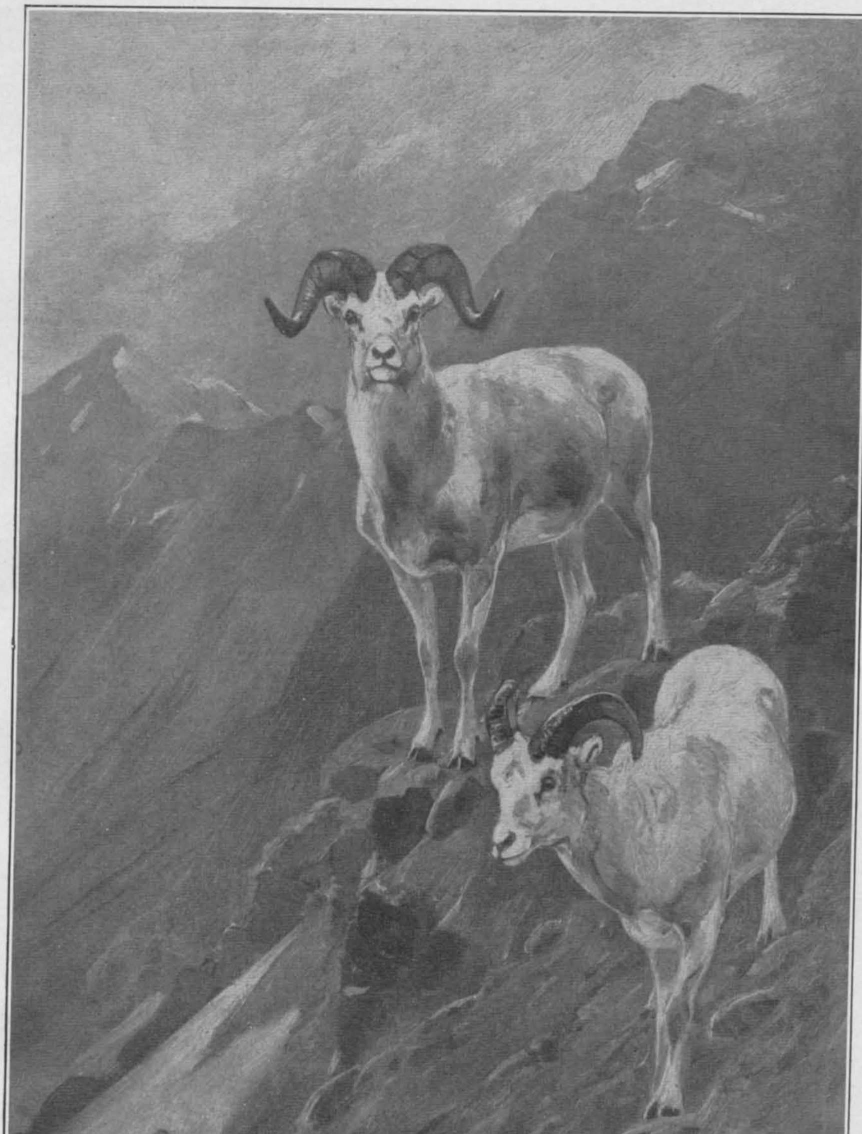
MOUNTAIN SHEEP.

Only one species of mountain sheep lives in Alaska, the white or Dall sheep (*Ovis dalli*).[a] It differs decidedly from the well-known bighorn or Rocky Mountain sheep, being practically pure white in color, somewhat smaller in size, and having more slender and rather more gracefully curved horns. Its former range included practically

[a] Although sometimes attributed to Alaska, both the Rocky Mountain sheep (*Ovis canadensis*) and the gray or Stone's sheep (*Ovis dalli stonei*) find their northern limits in Canadian territory.



THE ALASKA MOOSE (ALCE AMERICANUS GIGAS).



THE WHITE MOUNTAIN SHEEP OF ALASKA (OVIS DALLI).

all the mountains of the interior of Alaska and at present it is absent only from those mountains which lie near permanent settlements. It prefers the higher altitudes, and in any given group of mountains is usually most abundant about the main divide and the higher or more central peaks. It does not inhabit, and so far as known never has inhabited, the mountains of the Alaska Peninsula or the coastal slopes of the mountains of southeastern Alaska, but large numbers live on the Kenai Peninsula, the Endicott Mountains, Mount McKinley, and adjoining parts of the Alaska Range. It still lives in small numbers on some of the higher peaks between the Yukon and

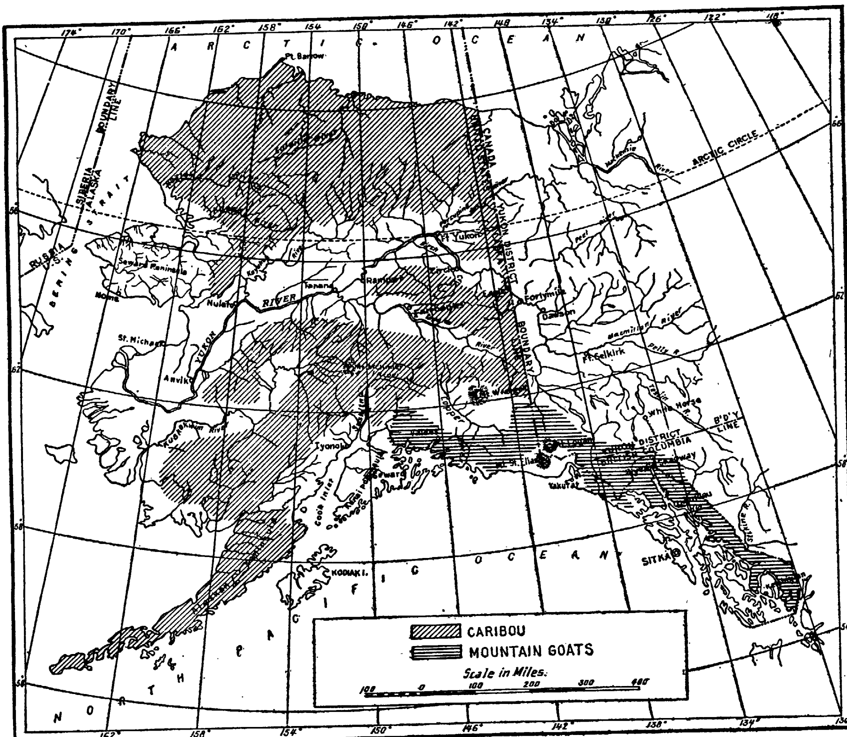


FIG. 50.—Distribution of caribou and mountain goats in Alaska.

Tanana rivers, but is in great danger of extirpation in this region It appears to range regularly on the Arctic slope north of the Endicott Mountains at rather slight altitudes, even to within a few miles of the coast. (See Pl. LVII and fig. 51.)

The habits of the white sheep are similar to those of kindred species. Their lives for the most part are spent on the wild, exposed, and forbidding mountain tops, but they do not hesitate to descend into timber. They may even take long journeys, passing all obstacles, swimming rivers, and traveling for miles through heavy forests, but their natural home, even during the severities of Arctic

winter, is above timber line. In summer this is by no means an inhospitable region, for however numerous may be the cliffs, the rocky pinnacles, and the hanging snowbanks, below and around them are always the mountain gardens, saucer-like basins studded with tiny ponds, or long fan-shaped slopes traversed by trickling streams and luxuriant with low matted vegetation. The sheep feed largely on these high slopes and meadows, but move about a great deal, and their well-marked trails show that they visit almost all parts of the mountains. Although their reputation for agility and surefootedness is well founded, their trails seldom if ever pass through such

FIG. 51.—Distribution of mountain sheep in Alaska.

rough ground as to daunt an active man of experience. They are keen of vision and, unlike most game animals, depend little upon scent for warning of danger, but in spite of this it is no easy task to approach one of these alert, far-sighted animals on an open mountainside. To those physically equipped for it hunting mountain sheep is unquestionably one of the greatest of sports, and Alaska is one of the best fields for it in the world. To the inspiring and exhilarating joys of mountaineering are added the uncertainties and excitements of the chase. Whether bearing gun or camera the hunter

pits not only his skill and cunning but also his strength and agility against those of the animal.

MOUNTAIN GOAT.

The higher parts of the mountains of the southeastern coast of Alaska, although eschewed by sheep and caribou, are inhabited by white mountain goats (*Oreamnos montanus*).[a] They are confined almost entirely to the coast side of the mainland mountains, as they rarely extend far into the interior or to the islands lying near the coast. Their range in Alaska is thus a narrow strip extending from Portland Canal northwest to the western spurs of the Chugach Mountains near the head of Cook Inlet. Although unevenly distributed goats are fairly common throughout most of this region and can be found within comparatively short distances of busy towns, as Ketchikan, Wrangell, Juneau, Skagway, and the settlements on Prince William Sound. (See fig. 50.)

With the exception of the pronghorn antelope the mountain goat is zoologically the most peculiar of American game animals, and with the possible exception of the musk ox its habits are the least known. Despite its name it is not a goat, nor is it an antelope, though having more in common with the antelopes than with the true goats. At present its nearest relatives are the curious Asiatic serows and gorals and the well-known chamois, all of which belong to a group collectively termed goat-antelopes. It lives almost entirely at high altitudes, frequenting steep cliffs, rock-walled canyons, and summits of an even more forbidding nature than those traversed by mountain sheep. To approach a mountain goat successfully is more a feat of mountaineering than of crafty hunting. This is partly because the goat keeps watch only over the country below him, so it is necessary to get above—and to get above a white goat is in most cases to get to the ultimate heights. But the scenery of the mountains on the Alaskan coast is among the finest in the world, and one who has good lungs and strong legs has little cause to regret that the goat leads him among crags and peaks.

The flesh of the mountain goat, except in young animals, is strong and not especially palatable, while its hide has little commercial value. Moreover, the animal can not be obtained by lazy methods, and hence is in no danger of extirpation. It has short, strong legs, a short neck, and a thick, heavy body, withal presenting a clumsy appearance quite the reverse of what might be expected from the precarious nature of its habitat. The horns, which are present in both sexes,

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[a] The goats of the Alaska coast belong to the subspecies *columbianus* and *kennedyi*, distinguished by large size and cranial characters, but their respective ranges and relationships are not thoroughly known.

are small, recurved, polished, and blackish. They range from 7 to 10 inches in length. The hair is long, shaggy, and, when unstained, pure white.

DEER.

Although the greater part of Alaska is without small deer (*Odocoileus*) the southeastern coast region or "panhandle" is greatly favored in this respect. Only one variety occurs, the so-called Sitka deer (*Odocoileus columbianus sitkensis*), but this one is exceedingly abundant, although the region inhabited by it lies well beyond the northern limits of any other American deer. It is a variety of the Columbia blacktail, from which it differs chiefly in smaller size, and in having the upper side of the tail more extensively brownish. Like the blacktail and mule deer, it is a "bounding" deer and in flight pursues a zigzag course, alighting on all four feet at once after each leap. Unlike the whitetail, it does not raise its tail or "flag" when running. In size it is small, ordinary bucks weighing less rather than more than 100 pounds. Its rather small antlers are similar in form to those of the mule deer and are perhaps the least impressive of those of North American deer. It inhabits practically all the Alexander Archipelago and the adjacent mainland from British Columbia to the vicinity of Juneau. Throughout this region it ranges from seacoast to timber line in forests and undergrowth almost unequaled in density and luxuriance. Except for its great abundance this deer might be rarely seen, for its cunning is not less than that of others of its kind and its habitat affords unusual protection. But it occurs in such numbers throughout most of its range that in spite of the numbers killed in the past it still may be found with no great difficulty. Previous to the enactment of the Alaska game law deer were killed by hundreds and even thousands merely for their hides, which netted the hunter a few cents apiece. This ruthless waste is now stopped, and since good local sentiment bids fair to prevail the deer will doubtless hold their own. (See fig. 49.)

BEARS.

Alaska is without a rival in respect to number and variety of bears. No fewer than 13 kinds, as recognized by recent mammalogists, live in the Territory. These, however, belong to only 4 general types and fall naturally into 4 groups, the brown bears, the grizzlies, the black bears, and the polar bears.

The brown bears are the most numerous and most important. Zoologically their relationships are with the Old World brown bears rather than with any American species. They are of huge size, being much larger than the grizzlies and all other bears except the polar bear and their own relatives of Kamchatka. Therefore the state-

ment, often made, that they are the largest carnivorous animals in the world needs little if any qualification. They are confined almost exclusively to the coast region, ranging from Bering Sea throughout the Alaska Peninsula and some outlying islands and thence south along the Pacific coast nearly or quite to British Columbia. Many of the islands of the Alexander Archipelago are inhabited by them and also the near-by mainland. Their color varies greatly, ranging from dark seal brown to buffy brown, the feet, legs, and underparts usually being darker than the shoulders and back. Although the ends of the hairs are often paler than the bases the silver-tipped effect of the grizzlies is wanting. The front claws are shorter, thicker, and more abruptly curved than in the grizzlies.

It is often said that the brown bears are less ferocious than the grizzlies, but the evidence is conflicting. Certainly they are more powerful and at close quarters correspondingly dangerous. They come out of hibernation early in the spring, usually in April. When the salmon begin to run they feed largely on them and on this account have been called fish bears, or fish-eating bears, although other bears have the same habit. They eat a great variety of other food, however, including kelp and shellfish secured about the mouths of streams and along tide flats, and also berries, roots, ground squirrels, and mice obtained on higher ground.

The brown bears of Alaska will doubtless become very rare or extinct at no very distant date. Such formidable carnivorous animals, even though not inclined to attack human beings, are commonly regarded as a menace to the safety of travelers and therefore undeserving of protection. Already, they have become scarce on Kodiak Island where formerly very abundant, and on the Alaska Peninsula, though still fairly numerous, they are being killed at a rate probably greatly in excess of their increase. In the heavy forests of southeast Alaska and in the region of Mount St. Elias they may hold their own longer.

The varieties of brown bears as at present classified are as follows: The Kodiak bear (*Ursus middendorffi*), inhabiting Kodiak Island; the Alaska Peninsula bear (*Ursus dalli gyas*), of the Alaska Peninsula; the Yakutat bear (*Ursus dalli*), of the vicinity of Yakutat Bay and the coast north and south for undetermined distances; the Sitka bear (*Ursus sitkensis*) of Baranof Island; the Admiralty bear (*Ursus eulophus*), of Admiralty Island; and the Kidder bear (*Ursus kidderi*), of the Alaska Peninsula. With the exception of the last three, which are smaller than the others and of uncertain relationships, all the brown bears are similar in general characters and external appearance, the varietal distinctions being based mainly upon cranial characters obvious only to professional mammalogists.

The grizzly bears of Alaska belong to at least two varieties, one (*Ursus horribilis phœonyx*) of the interior, the other (*Ursus kenaiensis*) of the Kenai Peninsula and adjacent coast region. They are generally distributed in these regions and although not common near settled and traveled parts are often met in unexpected places. Their habits are similar to those of the well-known grizzlies of the western part of the United States. They spend the summer chiefly above and near timber line and in such places are not infrequently encountered by the mountain sheep hunter. Like most bears, however, they are seldom caught unawares. They roam widely, are very keen-scented, and get out of danger with great ease and alacrity. At present they are perhaps most numerous in the Endicott Mountains and the Nutzotin and Alaskan Mountains, including the region of Mount McKinley.

Black bears (*Ursus americanus*) are fairly common throughout all Alaska south and east of the treeless tundra. They are among the shyest of animals and many doubtless slip away without allowing themselves to be seen. Thus in many districts where fairly common they are supposed to be scarce. The cinnamon variety is very common in the interior but rare or almost unknown on the coast. The northern and interior black bears of Alaska are the same as those of eastern North America, but those of Prince of Wales Island off the extreme southeast coast appear to belong to a larger subspecies (*Ursus americanus carlottæ*), in which the cinnamon phase is unknown.

Belonging with the black bear group is the rare and interesting glacier bear (*Ursus emmonsi*), inhabiting the southern slopes of the St. Elias Range and near-by mountains, at least from Cross Sound to the vicinity of Cape St. Elias. It is supposed to live near the numerous glaciers of this region, but its habits are practically unknown and, so far as reported, it has never been killed by a white man. Scarcely a dozen specimens, mostly imperfect, are contained in the museums of the world. The glacier bear is very similar in size and general characters to the black bear, differing mainly in color, which is silvery gray slightly mixed with black, the nose being brown and the feet blackish. In certain conditions of pelage the color has a somewhat slaty or bluish gray effect, hence the name " blue bear " sometimes applied to the animal.

The well-known polar bear (*Thalarctos maritimus*), which is no less common near the northern coast of Alaska than elsewhere in similar latitudes, completes the list of Alaska's bears. Owing to the remoteness of its habitat it is seldom seen except by whaling or exploring parties. During the cruise of the revenue steamer *Corwin*, E. W. Nelson found polar bears abundant about Herald Island and Wrangell Land in August, where doubtless they are still numerous. They have been found occasionally in summer on islands in Bering

Sea, notably St. Lawrence and Hall islands, but probably were left there by suddenly receding ice, so their occurrence in the summer season was accidental.

WALRUS.

Although the walrus is not always considered a game animal a paragraph may be devoted to it, since its imposing tusks are often sought by trophy hunters and since it has been protected by the Alaska game law. The Pacific walrus (*Odobenus obesus*), except for its larger size, is in all general features and in habits practically identical with the Atlantic animal. It is now rare south of Bering Strait, although formerly large numbers came south each season with the pack ice. In comparatively recent times also, several good-sized colonies of walrus lived throughout the year about the shores of Bering Sea, especially in Bristol Bay, but only the merest remnant of these is left. Unless earnest efforts are made to preserve this remnant not a walrus will be left south of the Arctic Ocean. On the Alaskan Arctic coast walrus still remain in considerable numbers, but even here their fate is uncertain, for no animal which produces articles of commerce is safe, however remote its habitat.

GAME BIRDS.

Alaska's game birds are mostly breeding waterfowl, the same well-known migratory species which spend all or part of the winter in the United States. Therefore, while the Territory is highly important as a refuge for large game, it is scarcely less so as a shelter for our surviving water birds. Ducks, geese, and wading birds, so recently abundant on our coasts and inland waters, are everywhere diminishing in numbers, and more than one species is threatened with extinction in the near future. Under such circumstances the innumerable ponds of the interior of Alaska and the lonely tundras of its northern coasts, in which many of these birds rear their young, become of the utmost importance. The birds arrive in the north early in the spring in April or May and after breeding leave for the south in August and September. Among them are great numbers of ducks, geese, swans, and vast hordes of small shorebirds, as plovers, snipes, curlews, and sandpipers. A large proportion of these stop in the United States in the fall or spend the winter there. Protective laws in the States therefore avail but little unless the birds are fully protected also on their breeding grounds. In proportion to the population pot hunters are no less numerous in Alaska than elsewhere. In fact they are perhaps more numerous, on account of the relatively large number of people leading an outdoor life and accustomed to the use of firearms. A further bad feature is the fact that most of the shooting is done on the arrival of the birds in the spring on their way to the breeding grounds.

Spring shooting is bad enough in the States, but in Alaska it is much worse, for every migrating bird has already escaped a multitude of previous dangers and, as it is just about to breed, is equivalent to at least four or five in the fall.

The gallinaceous game birds of Alaska consist of several varieties of ptarmigan and five species of grouse. The ptarmigan inhabit all the higher mountain tops of the coast and interior and the tundras of the Bering Sea and Arctic coast, including all the Aleutian Islands. Three principal varieties are permanent inhabitants of the Territory, the willow ptarmigan (*Lagopus lagopus*), the rock ptarmigan (*L. rupestris*), and the white-tailed ptarmigan (*L. leucurus*). They gather in immense flocks in the fall, frequenting low willow scrub, open tundras, and treeless mountain tops. Their flesh is relished in the north country, but is excelled by that of many other birds. The most common grouse is the Alaska spruce grouse (*Canachites canadensis osgoodi*), generally distributed in the interior and reaching the coast in the vicinity of Cook Inlet. It does not fly well and is usually killed with a small rifle while perched in a tree. Its flesh is fairly good at certain seasons and often finds its way to the prospector's frying pan. The gray ruffed grouse (*Bonasa umbellus umbelloides*) also inhabits most of the wooded interior and is no less a delight to the sportsman and epicure than its well-known eastern relatives. The sooty grouse (*Dendragapus obscurus fuliginosus*) is fairly common along the Pacific coast from British Columbia to Cook Inlet. It inhabits heavy forest and, like the spruce grouse, is usually hunted with a small rifle. Two other grouse are rare and seldom seen, the Columbian sharp-tailed grouse (*Pediœcetes phasianellus columbianus*), of limited distribution in the interior, and the Franklin grouse (*Canachites franklini*), recorded once from southeastern Alaska.

DISEASES OF ORNAMENTAL TREES.

By Haven Metcalf,

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INTRODUCTION.

Within the past few years there has been a notable increase of public interest in the culture of ornamental trees and shrubs. Attempts to cultivate new varieties or old varieties in new conditions and situations, and frequently by persons unfamiliar with the specific requirements of trees and shrubs, have too often resulted only in the production of short-lived and diseased specimens. Furthermore, several parasitic diseases of a serious nature have recently appeared; and it is therefore not surprising that many inquiries are received by the Bureau of Plant Industry regarding ornamental trees that are supposedly diseased. What all correspondents desire to know is, What is the matter with the tree or shrub in question and how can it be cured? Often no satisfactory answer can be given. Trees are particularly subject to troubles which are wholly due to abnormal conditions in their immediate surroundings and which call for actual inspection of tree and surroundings in order to diagnose the case. Or there often is no cure in the nature of the case; for example, there is no cure for old age.

The most widespread cause of disease of trees and shrubs is the attempt to grow them in a climate and situation for which the given species are not adapted. For example, such evergreens as the English yew, Scotch pine, and Irish juniper have, for sentimental reasons and in accordance with horticultural tradition, been planted extensively in the Eastern States. Unless in favorable situations and having exceptional care they are short lived, ragged, and susceptible to many diseases. There is essentially no need for the cultivation of such imported varieties, as in general the same effects may be obtained with native varieties or with varieties imported from regions of similar climate. If such trees are planted (and to those named may be added at least the Austrian pine, the silver fir, and the Norway spruce), it should be with the understanding that they must receive extra care.

In controlling diseases of ornamentals, the expense of the method employed is, within reason, no object compared with effectiveness.

A fine shade tree may, on account of its situation and associations, be worth many hundreds of dollars to its owner. If such a tree is diseased it is obvious that almost any measures may be resorted to, no matter how costly or time consuming, if they offer hope of cure. On the other hand, it should be remembered that at the present time the moving of large trees is, in expert hands, a perfectly practicable procedure, and no owner who is willing to incur reasonable expense needs to wait for a tree to grow in order to replace an old one or to shade a newly built house.

DISEASES DUE TO UNFAVORABLE SURROUNDINGS.

STARVATION.

The symptoms of starvation are quite diverse and have been but little studied. For various reasons they are commonly manifested on ornamental trees. In the forest the annual deposit of leaves keeps the top layers of soil in good condition. But in parks, lawns, and streets the leaves are raked up and hauled away, and the soil has either no covering or merely such as is afforded by clipped lawn grass. Not only is the soil thus deprived of plant food, but its surface becomes baked and in a dry summer may dry out to a depth sufficient to kill the upper feeding roots of the trees.

Where the soil is thus left in poor condition some fertilizer must be applied annually to the surface of the ground. Nothing is better than well-rotted stable manure, but as this is offensive in appearance and odor and in cities it is usually not practicable to work it into the soil, some commercial mixture is generally used. The following mixture has been extensively used:

	Pounds.
Nitrate of soda	50
Cotton-seed meal	300
Acid phosphate	100
Muriate of potash	100

Such a quantity, which should be mixed fresh for use, is sufficient for an acre of tree-covered land, i. e., excluding space not covered by tree branches. It should be sown under the trees when the buds open in the spring. In many localities an application of slaked lime is also beneficial.

The method of applying fertilizers in liquid form through holes in the ground appears to be efficient, but has not been experimented with sufficiently to warrant its general recommendation.

When trees must be set in unsuitable soil, a hole should be dug, at least 50 cubic feet of earth being removed, and this should be filled with good soil. The shape of the hole will of course have to depend on where the tree is to be grown, whether on lawn or sidewalk. In any case there should be as much space laterally as possible.

Symptoms of starvation are often to be observed in the surviving trees of clearings and parks that have been thinned out or cleared of undergrowth. Such clearing results at first in greatly stimulating the growth of the remaining trees, but it also causes rapid loss of humus from the soil surface, with the result that the trees may soon come to suffer from lack of both food and water. Improper association of species is a frequent cause of starvation. Very commonly hedges and shrubs are dwarfed because the roots of large neighboring trees are exhausting the soil. Digging a deep trench around such plants and cutting off the intruding roots will often relieve the situation and not injure the larger trees.

ROOT SUFFOCATION.

Trees differ greatly in their ability to withstand inadequate soil aeration, and this must be taken into account in selecting trees for city planting. What limited space is allowed each individual tree must not become hard, baked, or trodden down; it may be in sod or it can be spaded up to a depth of 6 to 10 inches each year, which will usually relieve the situation. In European cities it is the custom to cover the ground about a street tree with a metal grating, or "grill," which allows free access of air and protects the soil from being trodden hard. Such grills could be regularly used to advantage whenever the soil about a tree is limited in surface area and liable to be trodden hard. Aggravated cases of root asphyxiation are likely to occur in places where the ground water is very near the surface, as the water excludes the air. When a period of heavy rains, producing such a condition, is succeeded by drought, many trees succumb. The tulip tree and the beech, both beautiful park trees, are particularly sensitive in this regard and generally fail as street trees in consequence.

Young trees set too deep are often killed, while it is a familiar fact that covering the earth about trees with soil a foot or more deep usually results in injury, if not death, from the same cause. In grading this is often unavoidable.

GAS POISONING.

Trees growing within city limits are often killed by illuminating gas which finds its way to their roots from leaks in gas pipes. When trees die suddenly, without obvious cause, this possibility should be investigated. A leak of any considerable size kills quickly, often in a few hours, but a small leak may result simply in an unhealthy condition of a single tree or the death of only a part of it. Such cases are very difficult of diagnosis.

The symptoms of gas poisoning in fatal cases are fairly characteristic, but difficult to describe. The first effect is yellowing and

wilting of the foliage, with partial or complete defoliation. The sapwood is usually discolored, and if the injury occurs in the growing season it has a very marked and characteristic odor. The bark is loosened and very soon drops off in patches. From this time rotting of the dead wood proceeds more rapidly than on trees dead from other causes. In very bad cases the odor of gas may be apparent in the soil about the tree.

Nothing can be done in such cases except to stop the leak as soon as possible and dig up the ground about the tree in order to aerate it. Some workers also recommend replacing the earth with fresh soil and stimulating the tree with liberal applications of manure or nitrate of soda.

DRYING OUT.

Often the cloudy, cool, and moist weather of spring and early summer is followed by protracted hot, dry weather. Leaves formed under the former conditions are not able to resist the excessive transpiration induced by the dry weather and heat, and in consequence lose their water and wither, either completely or, more often, at the tips and edges.

To a considerable extent such injuries are unavoidable, but the harm may be lessened by any treatment that keeps the soil moist and aerated so that the foliage may have an ample supply of water to draw from. Mulching, when practicable, is beneficial, especially when combined with artificial watering.

During the summer of 1907 many trees, especially maples, were affected with an apparent disease of the leaves, in which the symptoms ranged from partially bleached spots (mosaic) in the leaf to dead tips and edges or even completely dead leaves and consequent defoliation. Such leaves were invariably found to be gorged with starch. While there can be little doubt that this trouble will find its explanation in the peculiarities of weather and water supply of the season in which it occurs, it is by no means the same as the simple condition of drying out just described, but is more probably a definite physiological disease. No recommendations can be made at this time looking toward its control.

EFFECTS OF COLD.

Freezing is in effect drying; the water is taken out of the tissues of the plant and changed for the time into ice. If the tissues are unable to take water again they necessarily die. Sometimes the injury is apparent as soon as the tissues have thawed, but many cases of winterkilling do not become evident until the vigorous growth of early summer begins.

In general the trees native to a given section resist injuries of this kind. Yet much can be accomplished in growing exotic trees, at

least to a certain age, by careful attention to their location, and if a naturally sheltered place is not available they can be protected by screens of native evergreens.

Many trees, especially smooth-barked ones, have their trunks and larger branches injured on the southwest side by the freezing and consequent death of patches of bark. During the warmer winter days there is sufficient heat at noon to stimulate portions of the growing layer into premature growth; such tissue is killed if cold weather follows immediately. The injury often does not become manifest until well into the summer. The dead tissue forms a favorable place for the growth of parasitic organisms and such a tree usually dies from rotting in a few years. This trouble must not be confused with that type of sun scald which is due simply to extreme heat in summer, when the growing layer may be literally cooked. Such cases occur most typically in the arid sections of the Southwestern States.

Trees that are worth the care are best protected by wrapping the parts liable to this sort of injury with straw or paper. Often merely shading the part liable to this injury with a board or shingles is sufficient to prevent it.

Another winter injury often confused with freezing is actual drying out. This may occur anywhere, but most typically in the higher altitudes of the West, where the dry and rarefied air and bright sun favor evaporation from the tree surface of more water than the roots can obtain from the cold and frequently sandy or gravelly soil. Evergreens are especially subject to this difficulty, since their leaves transpire to some extent throughout the winter. Whatever conserves the moisture of the soil tends to decrease this injury; for example, mulching and fall or winter irrigating. Trees normally hardy will often winterkill if unable to ripen their wood completely; this often happens as a result of defoliation in late summer.

SMOKE AND FUMES.

In manufacturing cities and in the vicinity of smelters, pulp and fertilizer mills, brick-kilns, coke ovens, and blast furnaces, particularly where sulphur gases are produced, the effects upon all kinds of foliage are very evident. The leaves become discolored, dead in spots, and finally entirely dead; this may be followed by diminished growth and death of the twigs. A chemical examination of the diseased leaves reveals the presence of sulphur trioxid in abnormal amounts. Usually the injury is first apparent at the top of the tree. The effect is cumulative, and with continued exposure the tree dies gradually from the top down. Different varieties of trees vary in their resistance to smoke injury. In general the evergreens are most sensitive, probably owing to the long life of their individual leaves

and the fact that they transpire in winter as well as in summer. Trees close to the source of smoke may be killed very quickly; the injurious effects decrease with distance, governed, however, by the direction of the prevailing winds and the configuration of the surrounding country, smoke of an injurious character tending to settle in the valleys.

Too often there is no remedy; either the manufactories or the trees must go. Yet in many cases tall smokestacks, by carrying the smoke high in the air, will save the surrounding vegetation. Condensing the poisonous gases, which may be of some value as a by-product, may be practicable. As not only trees but often all other vegetation is poisoned in this way, the entire matter has a legal phase, the discussion of which is beyond the sphere of this paper.

In parts of many cities the smokiness of the air, combined with the other unfavorable conditions to which all city trees are subject, makes it practically impossible to grow the ordinary street trees. The sycamore will stand as bad conditions of this sort as any good street tree, and on account of its habit of shedding annually the outer layers of its bark it presents a bright and clean appearance in the dirtiest surroundings. The ailanthus, an inferior tree and not otherwise to be recommended, is extremely resistant to smoke and dust and can be grown in situations where even the sycamore will scarcely thrive.

DISEASES DUE TO PARASITES.

Very few wood-rotting fungi are capable of entering an uninjured tree and beginning growth. Nearly all gain lodgment in wounds, grow in from these, and rot the wood. Hence, the prevention of wounds and their proper treatment are of the most fundamental importance in maintaining the health of trees.

INJURIES.

Ornamental trees are subject to mechanical injuries in a thousand ways. Street and lawn trees that are situated where horses can get at them are practically certain to have their bark gnawed off unless protected with some sort of guard. This is perhaps the commonest injury to trees. The injury shown in Plate LVIII, figure 1, is an extreme case, but can be duplicated on almost any city street. The exposed wood in this tree will soon rot, if not painted or otherwise protected, and the death of the tree is only a question of time. Mutilation in curb laying is usually necessary and unavoidable, but the wound can and should be treated; otherwise, rot-producing fungi find lodgment, and in a few years the base of the tree will be rotted out, as shown in figure 52. Fire is another frequent cause of injury at the base of the trunk, and so also, in the case of lawn trees, is collision with lawn mowers.

PLATE LVIII.

FIG. 1.—HORSE INJURY.

FIG. 2.—SLIME-FLUX.

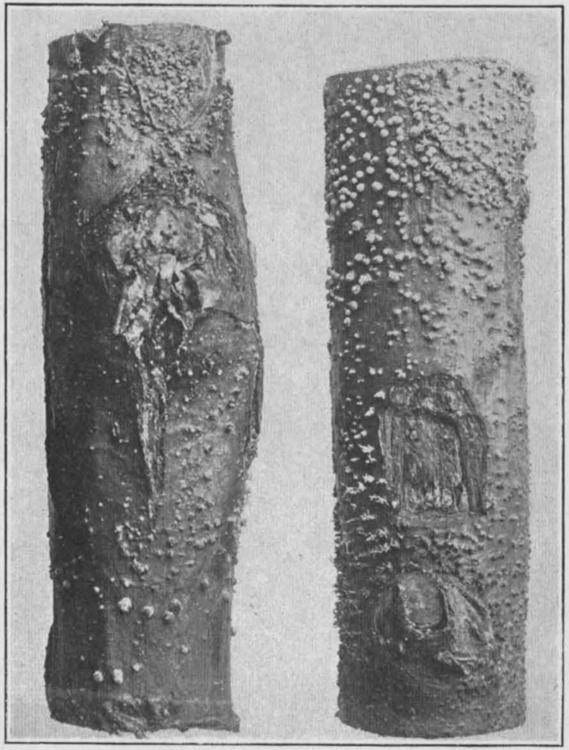

FIG. 3.—BARK DISEASE OF CHESTNUT.

Mutilation by stringing wires may or may not be avoidable in a given case, but it is certain that in the country at large telephone companies are responsible for an enormous amount of sheer vandalism in the unnecessary mutilation and destruction of trees. Remedies for this lie only in increased public interest and legal restriction. Finally, unskillful pruning and deliberate neglect of wounds are responsible for half of all the harm. Injuries from wind, hail, ice, storms, lightning, and other natural causes are largely unavoidable, but the resulting wounds can sometimes be treated.

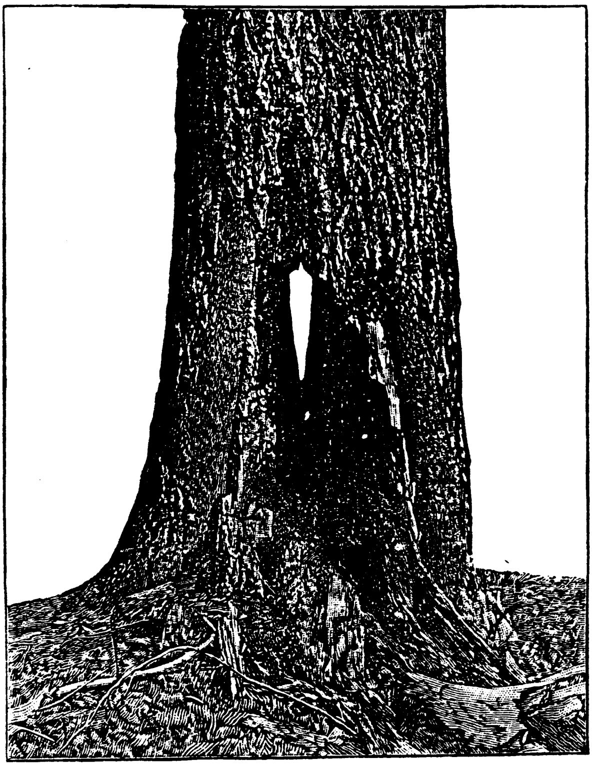

FIG. 52.—Hollow base, following an untreated wound.

SLIME-FLUX.

Sometimes, when an unprotected wound exudes sap in the spring, various apparently nonparasitic organisms—yeasts, bacteria, and fungi—will begin growing on the wound and soon form a slimy, dripping mass over its surface and running down from the wound. The cambium beneath dies rapidly, and the acids and other by-products of the action of the fermenting organisms appear to poison the wood, so that the wound can not possibly heal naturally. Such a case is shown in Plate LVIII, figure 2. This disease naturally affects the general health of the injured tree, and its death is often only a question of time. Death frequently results from girdling, the flux spreading from the wound until it completely surrounds the trunk or limb that it is on.

THE BARK DISEASE OF THE CHESTNUT.

Within three years the bark disease has proved very destructive to chestnut trees in New York and is spreading rapidly. If it continues to spread as it has begun it will become one of the most serious

tree diseases in the country. It already actively threatens the existence of the chestnut forests and orchards of the Eastern States.

The disease is caused by a fungus (*Diaporthe parasitica*). The spores of this fungus enter the tree through wounds, insect punctures, dead twigs, or dead wood anywhere; possibly also in other ways. From the point of infection the fungus grows in all directions through the growing layer and inner bark until the growth meets on the opposite side of the trunk or limb, which in this way is girdled.

The disease is very conspicuous and easy of diagnosis. On limbs with smooth bark the areas attacked by the fungus show dead, discolored, sunken patches of bark, covered more or less thickly with yellow, orange, or brown pustules of the fruiting fungus. (See Pl. LVIII, fig. 3.) If the spot is on the trunk or on a large limb with very thick bark there is no obvious change in the appearance of the bark itself, but the fungus shows in the cracks of the bark, and on account of the destruction of the layers beneath, the bark usually sounds hollow when tapped. A patch usually grows fast enough to girdle the branch or trunk that it is on by the end of the first summer, so that all parts of the tree above die the next spring, and from this time on the dead branches make the disease especially conspicuous. It is evident from this that the lower the infection occurs on the tree the sooner the death of the tree results.

The disease attacks all ages of chestnuts. Whether the trees are from coppice or from seed appears to make no difference. No varieties of chestnut appear to be entirely free, the disease occurring even on the chinquapin, but the Japanese varieties are in general resistant. This fact will prove to be of the utmost importance in the future of chestnut growing. The disease is not known to occur on any other trees than the chestnuts.

Everyone who has chestnut trees affected with this disease is advised to destroy them immediately, unless the trees are sufficiently valuable to be treated individually. The death of the diseased trees is only a matter of a short time, and by cutting them down immediately the danger of infecting trees still healthy is reduced to a minimum. In certain localities where the disease is just appearing it would undoubtedly be possible, by prompt cutting down or treatment of all infected trees and by very careful inspection, to maintain a zone free from the disease, and hence keep the disease out of the still uninfected country beyond. Individual trees may be treated by cutting the disease out of the tree and protecting it from further infections by special spraying. The details of this treatment will be sent to all inquirers. Such measures as watering the roots with copper sulphate or putting chemicals under the bark are futile.

HEART-ROT CAUSED BY THE FALSE-TINDER FUNGUS.

Plate LIX, figure 1, shows the false-tinder fungus (*Fomes igniarius*) growing on an American aspen. The spores of this fungus germinated in a wound, probably a broken or badly pruned limb, and the mycelium or threads of the fungus grew into the heartwood and through it, converting it into a whitish, friable substance. Perhaps the second year after infection one of the punks (fruiting bodies) appeared on the outside and was soon followed by others. Since that time the punks have been discharging from the pores on their under surface an annual crop of spores ready to infect open wounds in neighboring trees. There is probably no external evidence of the disease except these punks. They will continue to grow in size and others may appear. The rotting of the heartwood will continue until the tree, checked in growth and become a mere shell of weak sapwood, is blown down by some storm or gust of wind. This is the story of thousands of trees. The trouble is preventable by properly treating the wounds.

This fungus will serve very well as a type of the heart-rotting parasites, of which there are a considerable number.

THE OYSTER FUNGUS.

Plate LIX, figure 2, shows the fruiting body of the oyster fungus growing on a linden. This fungus, which is one of the edible mushrooms, is frequently found on rotten wood. Presumably it does not initiate the rot of the tree, and it certainly is not an active parasite like the false-tinder fungus, but it materially hastens the decay and ultimate death of the tree. It may serve here as an example of many fungi, both pore bearing and gill bearing, which occur on rotten wood, but which, if parasites, are not actively so. Trees on which such fungi occur are to be treated like any rotten or hollow trees, as indicated below.

PERIDERMIUM ON THE PINE.

A conspicuous but in ornamental trees not especially important disease is shown in Plate LX, figure 1. It occurs on trees of all ages, but especially on young ones. In the cracks of the swelling the spores are produced in the form of a copious orange or reddish yellow powder. There is probably no cure for affected trees, although they will live for a long time. They had better be cut down, however, to avoid infecting other healthy evergreens.

ROOT ROT.

Plate LX, figure 2, shows a street tree as it appeared shortly after it was blown down by a sudden gust of wind in a summer

shower. It will be noted that the roots are mostly broken off short and are obviously rotten, and that the rot has extended up into the trunk, as is evident by the lines of discoloration that appear in the cross section of the trunk. On the left-hand side is an erect splinter of sound wood, the only sound wood at the base of the tree; the roots below this are the only sound roots. Before it was blown over this tree presented a fairly good appearance, although there was dead wood in the top, and at the base a little rotten wood; and partly on this wood and partly on the ground a great number of mushrooms. These were the fruiting bodies of the honey mushroom (*Agaricus melleus*), the mycelium of which was the cause of the rotting of the roots. This is a rather common and very dangerous disease, affecting many kinds of trees, forest and fruit as well as ornamental.

The particular danger of any root-rotting disease lies in the fact that the trees so affected are liable to be blown down without warning, and so become a menace to both life and property. Such rots as gain entrance through wounds at the base of the trunk can be prevented by properly treating the wounds, but other forms of the disease, including the example given, spread through the ground and are difficult to prevent. Careful inspection of such trees will, however, reveal the disease, and they can be cut down before they become dangerous. If the trees are not blown down they usually die suddenly in early summer, the foliage wilting completely. This is due to the final complete cutting off of the roots.

PREVENTION AND TREATMENT.

The best way of dealing with such diseases as are here considered is to prevent the fungi that cause rot from gaining a foothold on the trees: (1) By protecting the tree against injury and (2) by properly treating wounds.

PROTECTION AGAINST INJURY.

The mechanical protection of street trees by support, guard, and grill is too large a subject to be handled in an article of this scope. Practically every firm dealing in wire or rod iron puts some form of tree guard on the market, and to say what form is best would be difficult. The essential points are that a guard must be fairly presentable in appearance, strong enough for its particular use, must not offer a retreat for insects, must be as cheap as is consistent with efficiency, and either adjustable to the size of the tree or large enough to allow considerable growth. In too many cities one sees outgrown guards strangling the trees they are supposed to protect. Curb trees on a street with heavy traffic may have to be protected with sheet-iron or even boiler-iron guards against the hubs of vehicles, while wire netting is sufficient to protect against gnawing by horses.

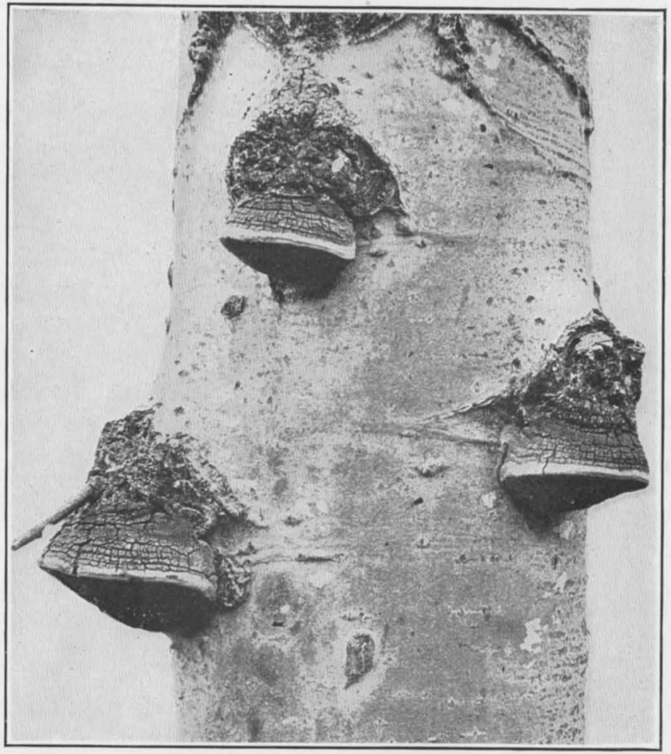

FIG. 1.—FALSE-TINDER FUNGUS ON AMERICAN ASPEN.

FIG. 2.—OYSTER FUNGUS ON LINDEN.

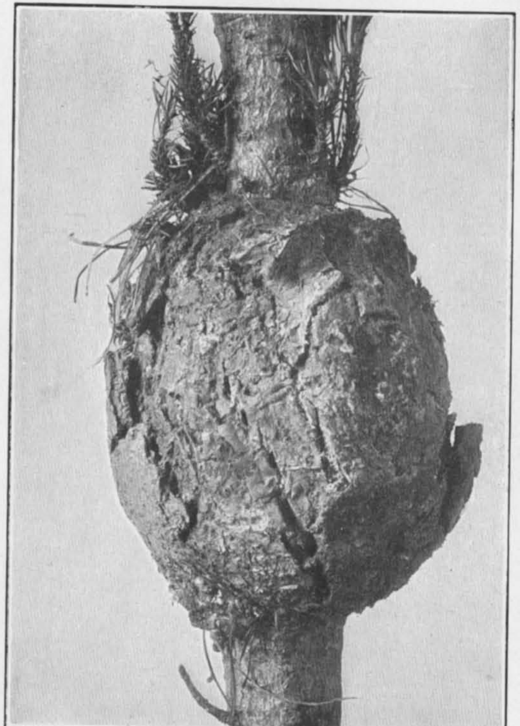

FIG. 1.—PERIDERMIUM ON PINE.

FIG. 2.—ROOT ROT OF MAPLE.

Unskillful trimming is a remediable form of mutilation from which all trees are liable to suffer. The proper way to cut off any limb, especially a large one, is closely and evenly with the trunk, without tearing away the bark on the under side. If a proper saw is used it is as easy to cut close as to leave a stub. If a cut is first made on the under side of the limb a foot or more from the trunk, then the limb sawed off from above, smoothly and close to the trunk, the limb will split from this lower cut and the slender stub thus left can be sawed off without tearing down any bark from below the wound.

After the removal of any branch more than 2 inches in diameter the wound, if perfectly healthy, must be painted with a heavy coat of lead and oil or covered with coal tar to exclude moisture, insects, and fungus spores and prevent the otherwise inevitable decay. While neither coal tar nor paint is entirely satisfactory, nothing better has yet been devised to take their place. When the cut is more than 4 inches in diameter, many workers prefer to tack over it a disk of sheet iron or tin before painting.

A fruitful source of injury in large ornamental trees is splitting from a fork in the large branches. Forks that are clearly liable to split in this way should be fastened together by a rod of iron or steel driven through holes bored directly through the branches and secured by a large head and nut. If the rod has to be very long it should be jointed in the middle to allow for lateral play. Bands of any kind should never be used, as they do not allow for growth and strangle the limbs in a few years.

TREE SURGERY.

When a part of a tree is already rotten or diseased special treatment is required. Absolutely all diseased or decaying tissue must be cut out, no matter how large a wound is made. A hatchet, mallet and chisel, or gouge, whichever is most convenient, may be used. The fresh surface left must then be sterilized by washing thoroughly with an antiseptic solution. Corrosive sublimate dissolved in water, 1 part to 1,000, or copper sulphate, 1 pound to 5 gallons of water, is recommended for this purpose. The wound is then painted or covered with coal tar.

If the wound is a very deep one in a large trunk or limb it may be desirable to fill it with cement made by mixing 1 part of Portland cement with 3 parts of clean, sharp sand. After this has had time to stiffen, but not to become perfectly hard, it should be faced off with thin mortar made of 1 part of cement and 1 part of sand. The edges of the wound should then be painted.

This is the standard treatment for all wounds when decayed tissue is involved. Hollow trunks may even be filled in this way, arresting

decay and strengthening the tree by the column of cement. Although many workers have obtained excellent results with this treatment without sterilization, it is bad practice to omit it. A sterilizing solution is very easily made up and readily applied, and its use makes sure what is otherwise uncertain. Where the rot is being produced by an active parasite, sterilization is imperative. Where the mycelium producing the disease is not all out or not all reached by the antiseptic solution, the rot may continue under the paint or cement and the entire work be a failure.

LEAF DISEASES.

Ornamental trees commonly suffer from a great number of diseases which spot the leaves and in extreme cases even defoliate the tree. While ordinarily they check the growth of the trees for one season only, if the disease appears several years in succession it may seriously weaken and even kill the tree. The most serious disease of this kind at present is the anthracnose on the leaves and twigs of the sycamore, which is one of the most useful city trees and otherwise generally free from enemies. During the summer of 1907 this disease, which is caused by a fungus often called *Gloeosporium nervisequum*, was generally prevalent throughout the country. In certain localities the symptoms of the disease were complicated with those of frost injury, from which the sycamores suffered seriously in the spring. A disease of the white pine in which the needles turn a characteristic reddish color and die has caused considerable alarm, especially in New England, and is now being investigated by this Department.

Most of the leaf diseases can probably be controlled by spraying, which should always be tried if the trees are of sufficient value to warrant it.

JAMES WALLACE PINCHOT.

By Joseph A. Arnold,

Editor and Assistant Chief, Division of Publications.

James Wallace Pinchot, the subject of this sketch (see frontispiece), was born at Milford, Pike County, Pa., in March, 1831. His father, Cyril Constantine Désiré Pinchot, a soldier of Napoleon, was compelled to leave France in 1816, upon the restoration of the Bourbons, because of his republican tendencies. He came to the United States and with his parents settled on the upper Delaware in Pennsylvania, becoming one of the largest land owners in that region. He was a man of great energy and was well known throughout the State of Pennsylvania and was selected by the President of the United States to visit western Indian tribes and settle differences between those Indians and the Government.

The mother of Mr. Pinchot was Eliza Cross Pinchot. Her grandfather was a Belgian nobleman, held a commission in the Continental Army, and ultimately settled in Pennsylvania.

In 1850, when 19 years old, Mr. Pinchot went to New York City, where he began business with William Henry Sheldon & Co. Later he became a member of the firm of Pinchot, Warren & Co., which was engaged in manufacturing in New York and Pennsylvania. He was a successful business man, and was able in 1875 to retire from business and devote his energies to philanthropic and other public undertakings.

Soon after he went to New York, Mr. Pinchot began to take an active interest in the artistic, literary, and educational development of the city. Greatly interested in art, he was one of the early subscribers to the Metropolitan Museum of Art, and his intimate friends among artists and literary men included Sanford Gifford (for whom his eldest son was named), Launt Thompson, Bayard Taylor, Edwin Booth, Parke Godwin, William Cullen Bryant, John Bigelow, E. C. Stedman, Whittredge, McEntee, and many others. Later General Sherman and General Stone were numbered among his intimate friends. He was one of the early members of the Century Club, the Union League Club, the Players' Club, and the Grolier Club in New York. He took an active part in establishing the National Academy of Design and the American Museum of Natural History, to both of which he contributed largely. He was a member of the New York Chamber of Commerce. He was the first treasurer, and a member of the executive board, of the Pedestal Committee of the Bartholdi

Statue of Liberty, to which he was an important contributor. He was active in organizing the first association in this country for providing model tenements for the poor, a subject in which he was deeply interested.

In Washington Mr. Pinchot was a member of the Cosmos and Metropolitan clubs. He was vice-president of the American Forestry Association, an associate of the Society of American Foresters, a patron of the Washington Academy of Sciences, and a member of the National Geographic Society.

Mr. Pinchot became interested in forestry through his observations of forest practice in France before the subject had attracted public attention in the United States. Later he became one of the founders of the Yale Forest School. His principal interest in forestry, however, centered in the Yale Summer School of Forestry, which he established and which is held upon his estate of Grey Towers at Milford. At this school the members of the entering class of the Yale Forest School receive their preliminary training in the field, and in addition about thirty young men acquire each year a preliminary knowledge of the forest and forest work.

In addition to the Yale Summer School of Forestry, Mr. Pinchot established, at Milford, the Milford Forest Experiment Station, the first to be established in the United States, at which experiments to determine the characteristics and uses of native trees are carried on.

Although he had traveled widely, Mr. Pinchot never lost interest in the town of Milford, where he was born. The old homestead of the Pinchots has been transformed into a free public library. Forest Hall, a large stone building, has been erected principally for the use of the Yale Summer School of Forestry, and in many other ways the town of Milford has felt the influence of his untiring interest in its welfare.

Mr. Pinchot was to the last a man of singularly keen interest in public affairs, of penetrating mind, of great vigor as well as great sweetness of disposition, and of an old-fashioned courtesy which peculiarly distinguished him.

In 1864 Mr. Pinchot married Mary Eno, daughter of Amos R. Eno, of New York. Their home was in New York until 1900, when they came to Washington. There are three children: Gifford, Chief of the United States Forest Service; Antoinette Eno, now Lady Johnstone, wife of Hon. Sir Alan Johnstone, British minister at Copenhagen; and Amos R. E., volunteer cavalryman during the Spanish-American war, until recently in the district attorney's office in New York, and now practicing law in that city.

In 1905 Mr. Pinchot received the degree of master of arts from Yale University in recognition of his services to the cause of forestry and his patronage of the fine arts.

The statement made by Professor Walker, the university orator, on the occasion of conferring the honorary degrees, is as follows:

A patron of art and education who united American birth and patriotism with the spirit of an ancestry derived from France; the son of a soldier of Napoleon who, leaving France in consequence of the Bourbon restoration, found a home in the new world, Mr. Pinchot has been deeply enlisted in efforts to promote friendliness of feeling between the two republics. As a consequence, and by reason of his well-known knowledge in matters of art, he served as one of the committee in charge of the erection in New York Harbor of Bartholdi's statue, "Liberty Enlightening the World." His clear perception of the ill certain to result to our country from the destruction of its forests led him to practical and efficient efforts for development in America of the scientific study of forestry. By this university his name is beloved and honored as that of a principal founder of its forest school, by which the training of a competent body of American experts in forestry, long sought by him, is being assured. With peculiar satisfaction we request that one already so usefully identified with Yale, and so helpfully efficient in artistic and educational progress, be numbered of her graduates by the conferment on Mr. Pinchot of the honorary degree of Master of Arts.

The following expression of sympathy was made by the Society of American Foresters after a special meeting held Saturday, February 8, at Washington, D. C.:

By the death of James W. Pinchot, one of its associate members, the Society of American Foresters feels that the cause of forestry in the United States has lost one of its earliest, wisest, and most effective supporters; the cause of forest education one of its most generous benefactors; the society, itself, an interested counselor and genial host, and the members individually a friendly and gracious presence.

The society expresses its deepest sympathy with Mrs. Pinchot and with the family in their bereavement.

At a meeting of officers of the Department of Agriculture, held in the office of the Secretary on February 8, 1908, the following resolutions were adopted:

Resolved, That in the death of James W. Pinchot an American citizen of the best type has passed away. Admirable alike for his civic virtues and public spirit, for his personal lovableness and unfailing courtesy, Mr. Pinchot attracted the regard of all who came in contact with him, while his generous gifts to American education give him high place among public benefactors.

Resolved, That, in particular, as a founder of the School of Forestry at Yale University, Mr. Pinchot takes his place among the great benefactors of American agriculture, in that, in the endowment of this school, an influence of far-reaching significance and increasing value to the conservation of our national resources has been set in motion.

Resolved, That the officers of the Department of Agriculture feel a keen sense of personal loss in the passing of Mr. Pinchot, whose thoughtful and kindly interest in their work was often manifested in appreciative ways.

Resolved, That a copy of these resolutions be given to the press and to the family of Mr. Pinchot.

C. Hart Merriam,
Beverly T. Galloway,
L. O. Howard,
Committee.

APPENDIX.

ORGANIZATION OF THE DEPARTMENT OF AGRICULTURE.[a]

SECRETARY OF AGRICULTURE, James Wilson.

The Secretary exercises personal supervision of public business relating to the agricultural industry. He appoints all the officers and employees of the Department with the exception of the Assistant Secretary and the Chief of the Weather Bureau, who are appointed by the President, and directs the management of all the Bureaus, Divisions, and Offices embraced in the Department. He exercises advisory supervision over agricultural experiment stations which receive aid from the National Treasury, has control of the quarantine stations for imported cattle, of interstate quarantine rendered necessary by sheep and cattle diseases, and of the inspection of cattle-carrying vessels, and directs the inspection of domestic and imported food products, under the meat-inspection and pure-food laws. He is charged with the duty of issuing rules and regulations for the protection, maintenance, and care of the National Forests. He is also charged with carrying into effect the laws prohibiting the transportation by interstate commerce of game killed in violation of local laws, and excluding from importation certain noxious animals; and he has authority to control the importation of other animals.

ASSISTANT SECRETARY OF AGRICULTURE, Willet M. Hays.

The Assistant Secretary performs such duties as may be required by law or prescribed by the Secretary. He also becomes Acting Secretary of Agriculture in the absence of the Secretary.

CHIEF CLERK, S. R. Burch.

The Chief Clerk has the general supervision of the clerks and employees; he is charged with the enforcement of the internal regulations of the Department; and is, by law, superintendent of the buildings occupied by the Department of Agriculture.

SOLICITOR, George P. McCabe.

The Solicitor acts as the legal adviser of the Secretary, and is charged with the preparation and supervision of all legal papers to which the Department is a party, and of all communications to the Department of Justice and to the various officers thereof, including United States attorneys. He examines and approves, in advance of issue, all orders and regulations promulgated by the Secretary under statutory authority; represents the Department in all legal proceedings arising under the various laws intrusted to the Department for execution, and prosecutes applications of employees of the Department for patents. He is also a member of the Board of Food and Drug Inspection.

APPOINTMENT CLERK, Joseph B. Bennett.

The Appointment Clerk prepares all papers involved in the making of appointments, transfers, promotions, reductions, details, furloughs, and removals, for the entire Department, and decides all questions relating to the civil-service regulations affecting the same. He has charge of all correspondence of the Department with the Civil Service Commission, and of all certifications and communications issued by the Commission to the Department; and he reports to the Commission all appointments and other changes in the service. He keeps the personal records of all employees of the Department, and is custodian of their oaths of office and efficiency reports. He is also custodian of the Department seal.

[a] The organization of the Department here given is in accordance with the act approved May 23, 1908, making appropriations for the fiscal year ending June 30, 1909, and shows changes in personnel to April 1, 1908.

CHIEF OF SUPPLY DIVISION, Cyrus B. Lower.

The Supply Division has charge of purchases of supplies and materials paid for from the general funds of the Department.

WEATHER BUREAU (corner Twenty-fourth and M streets NW.).—*Chief*, Willis L. Moore; *Assistant Chief*, Henry E. Williams; *Chief Clerk*, Daniel J. Carroll; *Editor of Monthly Weather Review*, Cleveland Abbe; *In charge of Division of Meteorological Records*, Frank H. Bigelow; *In charge of Instrument Division*, Charles F. Marvin; *In charge of Forecast Division*, Edward B. Garriott; *In charge of Special Research, and Forecaster*, Alfred J. Henry; *In charge of River and Flood Service, and Forecaster*, Harry C. Frankenfield; *In charge of Weather Bureau accounts*, Edgar B. Calvert. *Chiefs of Division: Climatological*, James Berry; *Publications*, John P. Church; *Telegraph*, Jesse H. Robinson; *Marine Meteorology*, Henry L. Heiskell; *Supplies*, Frank M. Cleaver; *Librarian*, Herbert H. Kimball. *In charge of Forecast Districts:* Henry J. Cox, Chicago, Ill.; Alexander G. McAdie, San Francisco, Cal.; John W. Smith, Boston, Mass.; Edward A. Beals, Portland, Oreg.; Isaac M. Cline, New Orleans, La.; Frederick H. Brandenburg, Denver, Colo.; Ferdinand J. Walz, Louisville, Ky. *Inspectors:* Norman B. Conger, Detroit, Mich.; Henry B. Hersey, Milwaukee, Wis. *Research Staff, Mount Weather, Va.: Supervising Director*, William J. Humphreys; *Observer in charge of Upper-Air Research*, William R. Blair; *Observer in charge of Magnetic Research*, Eric R. Miller.

The Weather Bureau has charge of the forecasting of weather; the issue of storm warnings; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gauging and reporting of river stages; the maintenance and operation of seacoast telegraph lines, and the collection and transmission of marine intelligence for the benefit of commerce and navigation; the reporting of temperature and rainfall conditions for the cotton, rice, sugar, and other interests; the display of frost and cold-wave signals; the distribution of meteorological information in the interests of agriculture and commerce; and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or are essential for the proper execution of the foregoing duties.

BUREAU OF ANIMAL INDUSTRY.—*Chief*, A. D. Melvin; *Assistant Chief*, A. M. Farrington; *Chief Clerk*, E. B. Jones; *Chief of Inspection Division*, Rice P. Steddom; *Chief of Quarantine Division*, Richard W. Hickman; *Chief of Pathological Division*, John R. Mohler; *Chief of Biochemic Division*, M. Dorset; *Chief of Dairy Division*, Ed. H. Webster; *Chief of Division of Zoology*, B. H. Ransom; *Superintendent of Experiment Station*, E. C. Schroeder; *Animal Husbandman*, George M. Rommel; *Editor*, James M. Pickens.

The Bureau of Animal Industry has charge of the work of the Department relating to the live-stock industry. It conducts the inspection of live stock, meats, and meat food products intended for interstate or foreign commerce, under the act of Congress of June 30, 1906, and also has charge of the inspection of import and export animals, the inspection of ships for the transportation of export animals, and the quarantine stations for imported animals. It investigates the existence of communicable diseases of live stock, makes original scientific investigations as to the nature, cause, and prevention of such diseases, and takes measures for their repression and eradication, frequently in cooperation with State and Territorial authorities. The Bureau also makes investigations in the breeding and feeding of animals and in regard to dairy subjects; inspects and certifies dairy products for export, and supervises the manufacture of and interstate commerce in renovated butter. Reports of scientific investigations and treatises on various subjects relating to the live-stock industry are prepared and published.

BUREAU OF PLANT INDUSTRY.—*Pathologist and Physiologist, and Chief*, Beverly T. Galloway; *Pathologist and Physiologist, and Assistant Chief*, Albert F. Woods; *Chief Clerk*, James E. Jones; *Editor*, J. E. Rockwell; *Pathologist in charge of Laboratory of Plant Pathology*, Erwin F. Smith; *Pathologist in charge of Investigations of Diseases of Fruits*, Merton B. Waite; *Pathologist in charge of Laboratory of Forest Pathology*, Haven Metcalf; *Pathologist in charge of Truck Crop Diseases and Plant Disease Survey*, William A. Orton; *Physiologist in charge of Plant Life History Investigations*, Walter T. Swingle; *Physiologists in charge of Cotton Breeding Investigations*, Archibald D. Shamel and Daniel N. Shoemaker; *In charge of Tobacco Investigations*, Archibald D. Shamel, Wightman W. Garner, and Ernest H. Mathewson; *Physiologist in charge of Corn Investigations*, Charles P. Hartley; *Physiologist in charge of Alkali and Drought Resistant Plant Breeding Investigations*, Thomas H. Kearney; *Physiologist in charge of Soil Bacteriology and Water Purification Investigations*, Karl F. Kellerman; *Bionomist in charge of Bionomic Investigations of Tropical and Sub-*

tropical Plants, Orator F. Cook; *Physiologist in charge of Drug and Poisonous Plant Investigations and Tea Culture Investigations*, Rodney H. True; *Physicist in charge of Physical Laboratory*, Lyman J. Briggs; *Expert in charge of Crop Technology and Fiber Plant Investigations*, Nathan A. Cobb; *Botanist in charge of Taxonomic and Range Investigations*, Frederick V. Coville; *Agriculturist in charge of Farm Management Investigations*, William J. Spillman; *Cerealist in charge of Grain Investigations*, Mark Alfred Carleton; *Horticulturist in charge of Arlington Experimental Farm*, Lee C. Corbett; *Pathologist in charge of Sugar-Beet Investigations*, Charles O. Townsend; *Agriculturist in charge of Western Agricultural Extension Investigations*, Carl S. Scofield; *Agriculturist in charge of Dry-Land Agriculture Investigations*, E. Channing Chilcott; *Pomologist in charge of Pomological Collections*, Gustavus B. Brackett; *Pomologists in charge of Field Investigations in Pomology*, William A. Taylor and G. Harold Powell; *Superintendent of Experimental Gardens and Grounds*, Edward M. Byrnes; *Superintendent of Vegetable Testing Gardens*, William W. Tracy, sr.; *Agricultural Explorer in charge of Foreign Seed and Plant Introduction*, David Fairchild; *Agrostologist in charge of Forage Crop Investigations*, Charles V. Piper; *Botanist in charge of Seed Laboratory*, Edgar Brown; *Crop Technologist in charge of Grain Standardization*, John D. Shanahan; *Pathologist in charge of Subtropical Laboratory and Garden, Miami, Fla.*, Ernst A. Bessey; *Expert in charge of Plant Introduction Garden, Chico, Cal.*, August Mayer; *Pomologist in charge of South Texas Garden, Brownsville, Tex.*, Edward C. Green; *Special Agent in charge of Farmers' Cooperative Demonstration Work*, Seaman A. Knapp; *Assistant in charge of Seed Distribution*, Lisle Morrison.

The Bureau of Plant Industry studies plant life in all its relations to agriculture.

Forest Service (Atlantic Building, 928–930 F street NW.).—*Forester and Chief*, Gifford Pinchot; *Associate Forester*, Overton W. Price; *Law Officer*, P. P. Wells; *Editor*, Herbert A. Smith; *Dendrologist*, George B. Sudworth; *Branch of Grazing, Assistant Forester in Charge*, Albert F. Potter; *Chief, Office of Control*, L. F. Kneipp; *Branch of Operation, Assistant Forester in Charge*, James B. Adams; *Assistant*, C. S. Chapman; *Chief, Office of Maintenance*, R. K. Helphenstine, jr.; *Fiscal Agent and Chief, Office of Accounts*, H. B. Cramer; *Assistant Chief*, E. A. Melzar; *Chief, Office of Organization*, Clyde Leavitt; *Assistant Chief*, Geo. H. Cecil; *Chief, Office of Engineering*, W. E. Herring; *Chief, Office of Lands*, A. C. Ringland; *Assistant Chief*, H. O. Stabler; *Branch of Silviculture, Assistant Forester in Charge*, William T. Cox; *Assistant*, E. E. Carter; *Chief, Office of Extension*, Samuel N. Spring; *Chief, Office of Silvics*, Raphael Zon; *Chief, Office of Management*, E. H. Clapp; *Assistant Chief*, W. G. Weigle; *Branch of Products—Assistant Forester in Charge*, William L. Hall; *Chief, Office of Wood Utilization*, R. S. Kellogg; *Assistant Chief*, McGarvey Cline; *Chief, Office of Wood Preservation*, W. F. Sherfesee; *Chief, Office of Publication*, Findley Burns.

The Forest Service has charge of the administration of the National Forests, and conducts examinations on the public lands to determine the propriety of making changes in the boundaries of existing National Forests and of withdrawing other areas suitable for new forests; gives practical assistance in the conservative handling of State and private forest lands; investigates methods of planting and kinds of trees for planting, and gives practical assistance to tree planters; studies commercially valuable trees to determine the best means of using and reproducing them; tests the strength and durability of construction timbers, railroad ties, and poles, and determines the best methods of extending their life through preservative treatment; and studies forest fires, the effects of grazing on forest land, turpentine orcharding, and other forest problems.

Bureau of Chemistry (corner of Fourteenth and B streets SW.).—*Chemist and Chief*; Harvey W. Wiley; *Assistant Chief*, W. D. Bigelow; *Associate Chemist*, F. L. Dunlap; *Board of Food and Drug Inspection*, H. W. Wiley, F. L. Dunlap, and G. P. McCabe, *Chief of Division of Foods*, W. D. Bigelow; *Chief Food and Drug Inspector*, Walter G. Campbell; *Chiefs of Food and Drug Inspection Laboratories:* New York, R. E. Doolittle; Boston, B. H. Smith; Philadelphia, C. S. Brinton; Chicago, A. L. Winton; New Orleans, C. W. Harrison; San Francisco, R. A. Gould; St. Paul, A. S. Mitchell; Detroit, H. L. Schultz; Buffalo, W. L. Dubois; Denver, A. E. Leach; *Sugar Laboratory*, under direction of the Chief of Bureau; *Chief of Miscellaneous Laboratory*, J. K. Haywood; *Chief of Dairy Laboratory*, G. E. Patrick; *Chief of Drug Laboratory*, L. F. Kebler; *Chief of Contracts Laboratory*, P. H. Walker; *Chief of Leather and Paper Laboratory*, F. P. Veitch; *Chief of Microchemical Laboratory*, B. J. Howard. *Special Investigations: Animal Physiological Chemistry*, F. C. Weber, *in charge*; *Vegetable Physiological Chemistry*, J. A. LeClerc, *in charge*; *Bacteriological Chemistry*, G. W. Stiles, jr., *in charge*, Washington; *Food Research*, M. E. Pennington, *in charge*, Philadelphia; *Enological Chemistry*, W. B. Alwood, *in charge*, Charlottesville, Va.; *Nitrogen Section*, T. C. Trescot, *in charge*; *Chief Clerk*, F. B. Linton.

The Bureau of Chemistry investigates methods proposed for the analysis of plants, fertilizers, and agricultural products, and makes such analyses as pertain in general to the interests of agriculture. The work on foods includes the analysis of adulterated products, experiments to determine the effect of adulterants on the human organism, experiments in the preparation of food products without preservatives, and allied investigations rendered necessary by the enforcement of the food and drugs act, the examination of food products imported into the United States, and of domestic foods and drugs in accordance with the food and drugs act, June 30, 1906. A corps of 35 inspectors directed by a chief inspector at Washington collects samples for examination, and inspects factories. The Bureau makes chemical analyses for other Bureaus and Divisions of the Department, and for other Departments of the Government which apply to the Secretary of Agriculture for such assistance, especially in the examination of supplies delivered under contract.

BUREAU OF SOILS.—*Chief*, Milton Whitney; *Chief Clerk*, A. G. Rice; *In charge of Soil Laboratories*, Frank K. Cameron; *In charge of Soil Survey*, Clarence W. Dorsey; *In charge of Soil Utilization Investigations*, Jay A. Bonsteel; *In charge of Soil Management*, Frank D. Gardner; *In charge of Fertility Investigations*, Oswald Schreiner; *In charge of Soil Erosion Investigations*, W J McGee.

The Bureau of Soils is intrusted with the investigation, survey, and mapping of soils; the investigation of the cause and prevention of the rise of alkali in the soil, and the drainage of soils.

BUREAU OF ENTOMOLOGY.—*Entomologist and Chief*, L. O. Howard; *Entomologist and Acting Chief in absence of Chief*, C. L. Marlatt; *Chief Clerk*, R. S. Clifton; *In charge of Breeding Experiments*, F. H. Chittenden; *In charge of Forest Insect Investigations*, A. D. Hopkins; *In charge of Cotton Boll Weevil Investigations*, W. D. Hunter; *In charge of Cereal and Forage Plant Insect Investigations*, F. M. Webster; *In charge of Deciduous Fruit Insect Investigations*, A. L. Quaintance; *In charge of Apicultural Investigations*, E. F. Phillips; *In charge of Gipsy Moth and Brown-tail Moth Work*, D. M. Rogers; *Engaged in White Fly Investigations*, A. W. Morrill; *In charge of Gipsy Moth Laboratory*, W. F. Fiske; *Engaged in Cattle Tick Life History Investigations*, W. A. Hooker; *Engaged in Tobacco Insect Investigations*, A. C. Morgan; *Engaged in Hydrocyanic Acid Gas Investigations*, R. S. Woglum; *Engaged in Silk Investigations*, C. J. Gilliss; *Assistant in charge of Editorial Work*, R. P. Currie; *Librarian*, Mabel Colcord.

The Bureau of Entomology obtains and disseminates information regarding injurious insects affecting field crops, fruits, small fruits, truck crops, forests and forest products, and stored products; studies insects in relation to diseases of man and other animals and as animal parasites; experiments with the introduction of beneficial insects and with the fungous and other diseases of insects; and conducts experiments and tests with insecticides and insecticide machinery. It is further charged with investigations in apiculture and sericulture. The information gained is disseminated in the form of general reports, bulletins, and circulars. Museum work is done in connection with the Division of Insects of the National Museum, and insects are identified for experiment stations and other public institutions and for private individuals.

BUREAU OF BIOLOGICAL SURVEY.—*Biologist and Chief*, C. Hart Merriam; *Administrative Assistant and Acting Chief in absence of Chief*, H. W. Henshaw; *Assistant in charge of Economic Investigations*, A. K. Fisher; *Assistant in charge of Game Preservation*, T. S. Palmer; *Assistant in charge of Geographic Distribution*, Vernon Bailey.

The Bureau of Biological Survey studies the geographic distribution of animals and plants, and maps the natural life zones of the country; it also investigates the economic relations of birds and mammals, and recommends measures for the preservation of beneficial and the destruction of injurious species. It is charged with carrying into effect the provisions of the Federal law for the supervision of interstate commerce in game and the importation and protection of birds, and certain provisions of the law for the protection of game in Alaska.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.—*Chief and Disbursing Clerk*, A. Zappone; *Assistant Chief*, Edgar B. Calvert; *Auditor*, Everett D. Yerby; *Cashier and Chief Clerk*, M. E. Fagan.

The Division of Accounts and Disbursements audits, adjusts, and pays all accounts and claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements and schedules for annual supplies and letters of authority; writes, for the signature of the Secretary, all letters to the Treasury Department pertaining to fiscal matters; issues requisitions for the purchase of sup-

plies and requests for passenger and for freight transportation; prepares the annual estimates of appropriations, and transacts all other business relating to the financial interests of the Department.

Division of Publications.—*Editor and Chief*, Geo. Wm. Hill; *Editor and Assistant Chief*, Joseph A. Arnold; *Associate Editor*, B. D. Stallings; *Assistant in charge of Document Section*, R. B. Handy; *Chief Clerk*, A. I. Mudd; *Assistant in charge of Indexing*, Charles H. Greathouse; *Assistant in charge of Illustrations*, Louis S. Williams.

The Division of Publications is charged with the supervision of the publication, printing, indexing, and illustration work of the Department. It edits, prepares for the printer, and reads the proof of all the bulletins, reports, circulars, blanks, blank books, etc., ordered for the various bureaus, divisions, and offices, with the exception of those of the Weather Bureau, and keeps the official record of all expenditures for printing and binding. It has immediate charge of the Yearbook and Farmers' Bulletins and controls the general printing and Farmers' Bulletin funds, and conducts all correspondence with the Government Printing Office. It issues, in the form of press notices, official information of interest to agriculturists, and distributes to agricultural publications and to newspaper correspondents notices and synopses of Department publications. It distributes all publications issued by the Department, excepting those of the Weather Bureau and those turned over by law to the Superintendent of Documents for sale at prices affixed by him.

Bureau of Statistics.—*Statistician and Chief*, Victor H. Olmsted; *Associate Statistician*, C. C. Clark; *Assistant Statistician*, Nat C. Murray; *Chief Clerk*, S. A. Jones; *Chief of Division of Foreign Markets*, George K. Holmes; *Chief of Division of Domestic Crop Reports*, F. J. Blair; *Chief of Editorial Division and Library*, Chas. M. Daugherty; *Crop Reporting Board:* Victor H. Olmsted, Charles C. Clark, Nat C. Murray, George K. Holmes, and one member selected from month to month from the corps of field agents and of State statistical agents.

The Statistician collects information as to the condition, production, etc., of the principal crops and the status of farm animals through State agents, each of whom is assisted by a corps of local reporters, through separate corps of county, township, and cotton correspondents, through traveling agents, and through a special foreign correspondent, assisted by consular, agricultural, and commercial authorities. He records, tabulates, and coordinates statistics of agricultural production, distribution, and consumption, the authorized data of governments, institutes, societies, boards of trade, and individual experts; prepares special statistical bulletins upon domestic and foreign agricultural subjects, and issues a monthly crop report for the information of producers and consumers. Special bulletins are published giving information of domestic and foreign trade and of the conditions under which foreign trade may be extended. Investigations are made of land tenures, cost of producing farm products, country-life education, transportation, and other lines of rural economics.

Library.—*Librarian*, Claribel R. Barnett; *Assistant Librarian*, Emma B. Hawks.

The Librarian has charge of the Library and supervises the arrangement and cataloguing of books, the preparation of bibliographies and similar publications, and the purchase of books. The mailing lists for the distribution of Department publications to foreign countries are under the supervision of the Librarian.

Office of Experiment Stations.—*Director*, A. C. True; *Assistant Director and Editor of Experiment Station Record*, E. W. Allen; *Chief of Editorial Division*, W. H. Beal; *Chief of Division of Insular Stations*, W. H. Evans; *Special Agent, Alaska*, C. C. Georgeson; *Special Agent, Hawaii*, Jared G. Smith; *Special Agent, Porto Rico*, D. W. May; *Expert in Nutrition Investigations*, C. F. Langworthy; *Chief of Irrigation Investigations*, S. Fortier; *Chief of Drainage Investigations*, C. G. Elliott; *Farmers' Institute Specialist*, John Hamilton; *Expert in Agricultural Education*, D. J. Crosby; *Chief Clerk*, Mrs. C. E. Johnston.

The Office of Experiment Stations represents the Department in its relation to the experiment stations, which are now in operation in all the States and Territories, and directly manages the experiment stations in Alaska, Porto Rico, and Hawaii. It seeks to promote the interests of agricultural education and investigation throughout the United States. It collects and disseminates general information regarding agricultural schools, colleges, and stations, and publishes accounts of agricultural investigations at home and abroad. It also indicates lines of inquiry for the stations, aids in the conduct of cooperative experiments, reports upon their expenditures and work, and in general furnishes them with such advice and assistance as will best promote the purposes for which they were established. In a similar way it aids in the devel-

opment of the farmers' institutes throughout the United States. It conducts investigations on the laws and institutions relating to irrigation in different regions, the use of irrigation waters in agriculture, the removal of seepage and surplus waters by drainage, and the use of different kinds of power and appliances for irrigation and drainage.

OFFICE OF PUBLIC ROADS.—*Director*, Logan Waller Page; *Assistant Director*, Allerton S. Cushman; *Chief Engineer*, Vernon M. Peirce; *Testing Engineer*, Philip L. Wormeley, jr.; *Chief Clerk and Chief of Records*, James Edmund Pennybacker, jr.

The Office of Public Roads collects and disseminates information concerning systems of road management throughout the United States; conducts investigations and experiments regarding road-building materials and methods of road construction; makes chemical and physical tests of road materials and materials of construction relating to agriculture; gives expert advice on road administration and road construction; demonstrates the best methods of construction, and prepares publications on these subjects.

APPROPRIATIONS FOR THE DEPARTMENT OF AGRICULTURE FOR THE FISCAL YEARS ENDING JUNE 30, 1906, 1907, AND 1908.

Object of appropriation.	1906.	1907.	1908.
Salaries, Statutory	$814,970.00	[a] $757,770.00	[a] $833,490.00
Library	8,040.00	10,000.00	12,500.00
Contingent Expenses	37,000.00	37,000.00	47,000.00
Collecting Agricultural Statistics	98,800.00	[b] 112,900.00	[b] 122,900.00
Plant Industry Bureau	....	502,301.28	586,559.40
Botanical Investigations and Experiments	63,840.00	(c)	(c)
Pomological Investigations	35,640.00	(c)	(c)
Grass and Forage Plant Investigations	39,660.00	(c)	(c)
Sugar Investigations	7,500.00	(c)	(c)
Tea Culture Investigations	8,500.00	(c)	(c)
Experimental Gardens and Grounds	20,320.00	(c)	(c)
Purchase and Distribution of Valuable Seeds	242,920.00	242,920.00	288,000.00
Vegetable Pathological Investigations	155,640.00	(c)	(c)
Grain Investigations, 1906	25,000.00	15,000.00	40,000.00
Chemistry Bureau, Laboratory	130,920.00	[d] 395,920.00	[d] 650,000.00
Forestry Investigations	793,180.00	1,021,410.25	1,917,507.26
National Forests, Administration, etc	....	1,050,000.00	1,666,709.15
Wichita Forest and Game Preserve	....	15,000.00	....
Survey and Report, Appalachian and White Mountain Watersheds, 1907 and 1908	....	25,000.00	[e] 23,403.76
Soil Investigations	170,000.00	185,000.00	170,000.00
Entomology Bureau	68,000.00	307,500.00	255,207.27
Biological Survey Bureau	44,420.00	44,420.00	44,420.00
Agricultural Experiment Stations [for stations under Hatch and Adams acts: $794,660, 1906; $1,056,000, 1907; $1,152,000, 1908]	74,660.00	83,565.15	107,065.15
Nutrition Investigations	20,000.00	20,000.00	5,000.00
Irrigation Investigations	74,500.00	122,200.00	150,000.00
Public Road Inquiries	37,660.00	57,660.00	57,660.00
Cotton Boll Weevil Investigations	190,000.00	230,000.00	185,632.42
Publications, Department of Agriculture	132,250.00	132,250.00	[f] 468,750.00
Animal Industry Bureau	1,456,520.00	[g] 3,946,980.00	[g] 3,947,200.00
Eradicating Cattle Ticks, 1907 and 1908	....	107,500.00	135,811.90
Animal Industry Bureau (deficiency act)	63,000.00	....	....
Building, Department of Agriculture	950,000.00	780,934.68	495,340.07
Total	5,719,700.00	10,118,451.36	12,210,156.38
WEATHER BUREAU.			
Salaries	191,340.00	194,690.00	196,990.00
Fuel, Lights, and Repairs	10,000.00	10,000.00	10,000.00
Contingent Expenses	10,000.00	10,000.00	10,000.00
General Expenses	1,093,565.00	630,000.00	645,000.00
Buildings	53,000.00	53,000.00	....
Cables and Land Lines	35,000.00	....	....
Salaries, Station Employees	....	541,550.00	551,550.00
Total, Weather Bureau	1,392,990.00	1,439,240.00	1,413,540.00
Grand total	7,112,690.00	11,557,691.36	13,623,696.38

[a] Statutory Salaries of Weather Bureau and Forest Service not included.
[b] Includes $4,900 for Foreign Markets Investigations.
[c] Included under Bureau of Plant Industry.
[d] Includes $250,000 for enforcement of Food and Drugs Act.
[e] Unexpended balance from 1907.
[f] Includes Yearbook and general printing funds.
[g] Includes $3,000,000 for meat inspection.

AGRICULTURAL COLLEGES AND OTHER INSTITUTIONS IN THE UNITED STATES HAVING COURSES IN AGRICULTURE.[a]

College instruction in agriculture is given in the colleges and universities receiving the benefits of the acts of Congress of July 2, 1862, and August 30, 1890, which are now in operation in all the States and Territories, except Alaska, Hawaii, and Porto Rico. The total number of these institutions is 65, of which 63 maintain courses of instruction in agriculture. In 21 States the agricultural colleges are departments of the State universities. In 15 States and Territories separate institutions having courses in agriculture are maintained for the colored race. All of the agricultural colleges for white persons and several of those for negroes offer four-year courses in agriculture and its related sciences leading to bachelors' degrees, and many provide for graduate study. About 59 of these institutions also provide special, short, and correspondence courses in the different branches of agriculture, including agronomy, horticulture, animal husbandry, poultry raising, cheese making, dairying, sugar making, rural engineering, farm mechanics, and other technical subjects. The officers of the agricultural colleges engage quite largely in conducting farmers' institutes and various other forms of college extension. The agricultural experiment stations with very few exceptions are departments of the agricultural colleges. The total number of persons engaged in the work of education and research in the land-grant colleges and the experiment stations in 1907 was 6,243; the number of students in these colleges, 66,193; the number of students (white) in the four-year college courses in agriculture, 3,738; in short and special courses, 5,334. There were also 1,659 students in agriculture in the separate institutions for negroes. With a few exceptions, each of these colleges offers free tuition to residents of the State in which it is located. In the excepted cases scholarships are open to promising and energetic students; and, in all, opportunities are found for some to earn part of their expenses by their own labor. The expenses are from $125 to $300 for the school year.

Agricultural colleges and other institutions in the United States having courses in agriculture.

State or Territory.	Name of institution.	Location.	President.
Alabama	Alabama Polytechnic Institute	Auburn	C. C. Thach.
	Agricultural School of the Tuskegee Normal and Industrial Institute.	Tuskegee Institute	B. T. Washington.
	Agricultural and Mechanical College for Negroes.	Normal	W. H. Councill.
Arizona	University of Arizona	Tucson	K. C. Babcock.
Arkansas	University of Arkansas	Fayetteville	J. N. Tillman.
	[b] Branch Normal College	Pine Bluff	Isaac Fisher.
California	University of California	Berkeley	B. I. Wheeler.
Colorado	The State Agricultural College of Colorado.	Fort Collins	B. O. Aylesworth.
Connecticut	Connecticut Agricultural College	Storrs	R. W. Stimson.
Delaware	Delaware College	Newark	G. A. Harter.
	State College for Colored Students	Dover	W. C. Jason.
Florida	University of the State of Florida	Gainesville	Andrew Sledd.
	Florida State Normal and Industrial School.	Tallahassee	N. B. Young.
Georgia	Georgia State College of Agriculture and Mechanic Arts.	Athens	A. M. Soule.
	Georgia State Industrial College	Savannah	R. R. Wright.
Idaho	University of Idaho	Moscow	J. A. MacLean.
Illinois	University of Illinois	Urbana	E. J. James.
Indiana	Purdue University	Lafayette	W. E. Stone.
Iowa	Iowa State College of Agriculture and Mechanic Arts.	Ames	A. B. Storms.
Kansas	Kansas State Agricultural College.	Manhattan	E. R. Nichols.
Kentucky	State University	Lexington	J. K. Patterson.
	The Kentucky Normal and Industrial Institute for Colored Persons.	Frankfort	J. H. Jackson.
Louisiana	Louisiana State University and Agricultural and Mechanical College.	Baton Rouge	T. D. Boyd.
	Southern University and Agricultural and Mechanical College.	New Orleans	H. A. Hill.
Maine	The University of Maine	Orono	G. E. Fellows.

[a] Including only institutions established under the land grant act of July 2, 1862.
[b] Does not maintain courses in agriculture.

Agricultural colleges and other institutions in the United States having courses in agriculture—Continued.

State or Territory.	Name of institution.	Location.	President.
Maryland	Maryland Agricultural College	College Park	R. W. Silvester.
	Princess Anne Academy, Eastern Branch of the Maryland Agricultural College.	Princess Anne	F. Trigg.
Massachusetts	Massachusetts Agricultural College.	Amherst	K. L. Butterfield.
	[a] Massachusetts Institute of Technology.	Boston	Henry S. Pritchett.
Michigan	Michigan State Agricultural College.	East Lansing	J. L. Snyder.
Minnesota	The University of Minnesota	Minneapolis	C. Northrop.
Mississippi	Mississippi Agricultural and Mechanical College.	Agricultural College	J. C. Hardy.
	Alcorn Agricultural and Mechanical College.	Alcorn	L. J. Rowan.
Missouri	College of Agriculture and Mechanic Arts of the University of Missouri.	Columbia	R. H. Jesse.
	[a] School of Mines and Metallurgy of the University of Missouri.	Rolla	G. E. Ladd.
	Lincoln Institute	Jefferson	B. F. Allen.
Montana	Montana Agricultural College	Bozeman	Jas. M. Hamilton.
Nebraska	Industrial College of the University of Nebraska.	Lincoln	E. B. Andrews.
Nevada	University of Nevada	Reno	J. E. Stubbs.
New Hampshire	New Hampshire College of Agriculture and the Mechanic Arts.	Durham	W. D. Gibbs.
New Jersey	Rutgers Scientific School (The New Jersey State College for the Benefit of Agriculture and the Mechanics Arts.)	New Brunswick	W. H. S. Demarest.
New Mexico	New Mexico College of Agriculture and Mechanic Arts.	Agricultural College	Luther Foster.
New York	Cornell University	Ithaca	J. G. Schurman.
North Carolina	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh	G. T. Winston.
	The Agricultural and Mechanical College for the Colored Race.	Greensboro	J. B. Dudley.
North Dakota	North Dakota Agricultural College.	Agricultural College	J. H. Worst.
Ohio	Ohio State University	Columbus	W. O. Thompson.
Oklahoma	Oklahoma Agricultural and Mechanical College.	Stillwater	J. H. Connell.
	Agricultural and Normal University.	Langston	I. E. Page.
Oregon	Oregon State Agricultural College.	Corvallis	W. J. Kerr.
Pennsylvania	The Pennsylvania State College	State College	Jas. A. Beaver.[b]
Rhode Island	Rhode Island College of Agriculture and Mechanic Arts.	Kingston	Howard Edwards.
South Carolina	The Clemson Agricultural College of South Carolina.	Clemson College	P. H. Mell.
	The Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina.	Orangeburg	T. E. Miller.
South Dakota	South Dakota State College of Agriculture and Mechanic Arts.	Brookings	Robert L. Slagle.
Tennessee	University of Tennessee	Knoxville	Brown Ayres.
Texas	Agricultural and Mechanical College of Texas.	College Station	H. H. Harrington.
	Prairie View State Normal and Industrial College.	Prairie View	E. L. Blackshear.
Utah	The Agricultural College of Utah	Logan	J. A. Widtsoe.
Vermont	University of Vermont and State Agricultural College.	Burlington	M. H. Buckham.
Virginia	The Virginia Agricultural and Mechanical College and Polytechnic Institute.	Blacksburg	P. B. Barringer.
	The Hampton Normal and Agricultural Institute.	Hampton	H. B. Frissell.
Washington	State College of Washington	Pullman	E. A. Bryan.
West Virginia	West Virginia University	Morgantown	D. B. Purinton.
	The West Virginia Colored Institute.	Institute	J. McH. Jones.
Wisconsin	University of Wisconsin	Madison	Chas. R. Van Hise.
Wyoming	University of Wyoming	Laramie	J. D. Towar.[b]

[a] Does not maintain courses in agriculture.
[b] Acting president.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, DIRECTORS, AND PRINCIPAL LINES OF WORK.

Station, location, and director.	Principal lines of work.
Alabama (College), Auburn: J. F. Duggar	Field experiments; plant breeding; soil improvement; feeding experiments; entomology; diseases of plants and animals; analysis of fertilizers.
Alabama (Canebrake), Uniontown: F. D. Stevens[a]	Agronomy; horticulture; floriculture; plant breeding; diseases of plants.
Alabama (Tuskegee), Tuskegee Institute: G. W. Carver	Agronomy; horticulture; diseases of plants; animal industry; poultry investigations; dairying.
Alaska, Sitka (Copper Center, Rampart, Kenai, Kadiak, and Fairbanks): C. C. Georgeson[b]	Agronomy; plant introduction; plant breeding; horticulture; animal husbandry; dairying; meteorology.
Arizona, Tucson: R. H. Forbes	Chemistry; botany; agronomy; horticulture; improvement of ranges; animal husbandry; plant diseases; irrigation.
Arkansas, Fayetteville: W. G. Vincenheller	Chemistry; soil physics; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; dairying; entomology; poultry experiments; nursery inspection.
California, Berkeley: E. J. Wickson	Chemistry; soils; bacteriology; fertilizer control; agronomy; horticulture, including viticulture and zymology; botany; meteorology; entomology; animal husbandry; dairying; poultry experiments; irrigation and drainage; silviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.
Colorado, Fort Collins: L. G. Carpenter	Chemistry; meteorology; agronomy; horticulture; forestry; plant breeding; diseases of plants; animal husbandry; veterinary investigations; entomology; irrigation.
Connecticut (State), New Haven: E. H. Jenkins	Chemistry; inspection of fertilizers, foods, feeding stuffs, Babcock test apparatus, and nurseries; diseases of plants; plant breeding; forestry; agronomy; entomology; investigation of vegetable proteids.
Connecticut (Storrs), Storrs: L. A. Clinton	Dairy bacteriology; agronomy; horticulture; plant breeding; poultry culture; dairying.
Delaware, Newark: Harry Hayward	Chemistry; mycology; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology.
Florida, Gainesville: P. H. Rolfs	Chemistry; agronomy; horticulture; diseases of plants; feeding experiments; veterinary science; entomology.
Georgia, Experiment: M. V. Calvin	Chemistry; agronomy; bacteriology; horticulture; plant breeding; plant diseases; entomology; animal husbandry; dairying.
Hawaii, Honolulu: J. G. Smith[b]	Chemistry; analysis of soil and feeding stuffs; agronomy; horticulture; packing and shipping of tropical fruits; plant breeding; entomology; apiculture; sericulture; rubber investigations; rice investigations.
Idaho, Moscow: H. T. French	Chemistry; physics; botany; agronomy; horticulture; plant breeding; diseases of plants; entomology; animal husbandry; irrigation; dairying; dry farming; wheat investigations; fruit by-products.
Illinois, Urbana: E. Davenport	Chemistry; soil physics; bacteriology; agronomy; horticulture; forestry; plant breeding; diseases of plants and animals; animal husbandry; dairying.
Indiana, Lafayette: Arthur Goss	Chemistry; soils; agronomy; horticulture; plant breeding; feeding stuff and fertilizer control; animal husbandry; dairying; diseases of plants and animals; entomology; agricultural extension work.
Iowa, Ames: C. F. Curtiss	Chemistry; botany; agronomy; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; poultry investigations; dairying; entomology; rural engineering; good roads investigations.

[a] Assistant director. [b] Special agent in charge.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Station, location, and director.	Principal lines of work.
Kansas, Manhattan: C. W. Burkett	Chemistry; soils; inspection of feeding stuffs and fertilizers; horticulture; plant breeding; agronomy; animal husbandry; poultry experiments; diseases of animals; dairying; entomology; extermination of prairie dogs and gophers; irrigation.
Kentucky, Lexington: M. A. Scovell	Chemistry; soils; inspection of fertilizers, foods, feeding stuffs, orchards, and nurseries; agronomy; horticulture; plant breeding; animal husbandry; dairying; diseases of plants; entomology; apiculture.
Louisiana (Sugar), New Orleans: W. R. Dodson	Chemistry; bacteriology; soils; agronomy; horticulture; sugar making; drainage; irrigation.
Louisiana (State), Baton Rouge: W. R. Dodson	Geology; botany; bacteriology; soils; inspection of fertilizers, feeding stuffs, and Paris green; agronomy; horticulture; animal husbandry; diseases of animals; entomology.
Louisiana (North), Calhoun: W. R. Dodson	Chemistry; soils; fertilizers; agronomy; horticulture; animal husbandry; stock raising; poultry experiments; dairying.
Maine, Orono: C. D. Woods	Chemistry; botany; inspection of foods, fertilizers, commercial feeding stuffs, seeds, and creamery glassware; mycology; pathology; nutrition of man and animals; poultry raising; plant breeding; entomology.
Maryland, College Park: H. J. Patterson	Chemistry; fertilizers; agronomy; horticulture; plant breeding; diseases of plants and animals; breeding of plants; animal husbandry; poultry experiments; dairying; entomology.
Massachusetts, Amherst: W. P. Brooks	Chemistry; meteorology; inspection of fertilizers, commercial feeding stuffs, creamery glassware, and nurseries; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; dairying; entomology; effect of electricity on plant growth.
Michigan, East Lansing: R. S. Shaw	Chemistry; analysis and control of fertilizers; bacteriology; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; stable hygiene; entomology.
Minnesota, St. Anthony Park, St. Paul: E. W. Randall	Chemistry; soils; fertilizers; agronomy; horticulture; forestry; diseases of plants and animals; food and nutrition investigations; plant breeding; animal husbandry; dairying; entomology; farm management; farm statistics.
Mississippi, Agricultural College: W. L. Hutchinson	Fertilizers; agronomy; horticulture; biology; plant breeding; animal husbandry; diseases of animals; poultry culture; dairying; entomology; agricultural engineering.
Missouri (College), Columbia: H. J. Waters	Chemistry; soil survey; botany; agronomy; horticulture; diseases of plants and animals; animal husbandry; plant breeding; dairying; entomology.
Missouri (Fruit), Mountain Grove: Paul Evans	Horticulture; vegetable pathology; entomology; inspection of orchards and nurseries.
Montana, Bozeman: F. B. Linfield	Chemistry; meteorology; botany; agronomy; dry farming; horticulture; animal husbandry; poultry experiments; dairying; entomology; irrigation and drainage.
Nebraska, Lincoln: E. A. Burnett	Chemistry; botany; meteorology; soils; agronomy; horticulture; plant breeding; diseases of plants and animals; forestry; animal husbandry; dairying; entomology; irrigation.
Nevada, Reno: J. E. Stubbs	Chemistry; botany; soils; meteorology; agronomy; horticulture; forestry; plant breeding; animal diseases; animal husbandry; veterinary science and bacteriology; zoology; entomology; irrigation.
New Hampshire, Durham: W. D. Gibbs	Chemistry; botany; agronomy; horticulture; plant breeding; animal husbandry; dairying; entomology.
New Jersey (State), New Brunswick: E. B. Voorhees New Jersey (College), New Brunswick: E. B. Voorhees	Chemistry; oyster culture; botany; analysis of fertilizers, foods, and commercial feeding stuffs; agronomy; horticulture; plant breeding; diseases of plants and animals; dairy husbandry; entomology; soil chemistry and bacteriology; irrigation.
New Mexico, Agricultural College: Luther Foster	Chemistry; botany; soils; agronomy; dry farming; horticulture; cactus and guayule plant investigations; animal husbandry; dairying; entomology; irrigation.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Station, location, and director.	Principal lines of work.
New York (State), Geneva: W. H. Jordan	Chemistry; bacteriology; meteorology; fertilizers; inspection of creamery glassware, feeding stuffs, fertilizers, and Paris green; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; poultry experiments; dairying; entomology; irrigation.
New York (Cornell), Ithaca: L. H. Bailey	Chemistry; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; poultry experiments; dairying; entomology.
North Carolina, West Raleigh: C. B. Williams	Chemistry; soils; agronomy; horticulture; animal husbandry; diseases of animals and plants; poultry experiments; dairying; tests of farm machinery.
North Dakota, Agricultural College: J. H. Worst	Chemistry; soils; botany; agronomy; plant breeding; horticulture; forestry; diseases of plants and animals; animal husbandry; poultry experiments; drainage; milling and chemical tests of wheat; inspection and analysis of foods, spraying materials, paints, proprietary products, and feeding stuffs.
Ohio, Wooster: C. E. Thorne	Chemistry; soils; agronomy; botany; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; entomology.
Oklahoma, Stillwater: W. L. English	Chemistry; agronomy; horticulture; plant breeding; forestry; botany; bacteriology; diseases of plants and animals; animal husbandry; entomology.
Oregon, Corvallis: J. Withycombe	Chemistry; bacteriology; soils; fertilizers; agronomy; horticulture; plant breeding and selection; diseases of plants; animal husbandry; poultry experiments; dairying; entomology; irrigation.
Pennsylvania, State College: T. F. Hunt	Chemistry; meteorology; fertilizers; horticulture; plant diseases; agronomy; animal husbandry; dairying.
Porto Rico, Mayaguez: D. W. May[a]	Agronomy; plant introductions; plant breeding; horticulture; fruit handling and shipment; chemistry; entomology; plant diseases; animal husbandry; coffee investigations.
Rhode Island, Kingston: H. J. Wheeler	Chemistry; meteorology; soils; inspection of fertilizers and feeding stuffs; agronomy; horticulture; plant breeding; poultry experiments.
South Carolina, Clemson College: J. N. Harper	Chemistry; inspection of fertilizers; soils; botany; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; dairying; veterinary science; entomology.
South Dakota, Brookings: J. W. Wilson	Chemistry; botany; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology; dairying.
Tennessee, Knoxville: H. A. Morgan	Chemistry; soil investigations; inspection of fertilizers; agronomy; horticulture; plant breeding; seeds; weeds; diseases of plants and animals; animal husbandry; poultry investigations; apiculture; dairying; entomology.
Texas, College Station: H. H. Harrington	Chemistry; botany and mycology; soils; agronomy; horticulture; animal husbandry; diseases of animals; entomology; irrigation; seed testing; feed inspection.
Utah, Logan: E. D. Ball	Chemistry; agronomy; horticulture; diseases of plants and animals; animal husbandry; dairying; poultry experiments; entomology; irrigation; arid farming.
Vermont, Burlington: J. L. Hills	Chemistry; botany; bacteriology; inspection of fertilizers, feeding stuffs, and creamery glassware; agronomy; horticulture; State nursery for forest-tree seedlings; diseases of plants; animal husbandry; dairying.
Virginia, Blacksburg: S. W. Fletcher	Chemistry; geology; biology; agronomy; horticulture; plant breeding; bacteriology; mycology; analysis of foods and soils; inspection of orchards; animal husbandry; veterinary science; dairying; entomology; cider and vinegar making; ferments.
Washington, Pullman: R. W. Thatcher	Chemistry; botany; bacteriology; soils; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; veterinary science; dairying; entomology; irrigation; dry farming.

[a] Special agent in charge.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Station, location, and director.	Principal lines of work.
West Virginia, Morgantown: J. H. Stewart	Chemistry; effect of pressure in the preservation of fruits, vegetables, and milk; artificial fixation of atmospheric nitrogen; inspection of fertilizers, orchards, and nurseries; soils; agronomy; horticulture; diseases of plants and animals; animal husbandry; poultry experiments; entomology.
Wisconsin, Madison: H. L. Russell	Chemistry; bacteriology; soils; agronomy; tobacco and cranberry culture; horticulture; plant breeding; animal husbandry; dairying; irrigation, drainage, and agricultural engineering.
Wyoming, Laramie: J. D. Towar	Chemistry; mycology; botany; meteorology; soils; range improvement; fertilizers; agronomy; plant selection; food analysis; animal husbandry; wool investigations; irrigation.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

President, J. L. Snyder, president of Michigan State Agricultural College, East Lansing, Mich.; secretary-treasurer, J. L. Hills, director of Vermont Experiment Station, Burlington, Vt.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES.

Farmers' Institute Specialist, Department of Agriculture.

John Hamilton, Washington, District of Columbia.

State superintendents.

State or Territory.	Name of official.	Post-office.
Alabama	C. A. Cary, Alabama Polytechnic Institute	Auburn.
	G. W. Carver, Director Agricultural Experiment Station.	Tuskegee Institute.
Alaska	C. C. Georgeson, Agricultural Experiment Station.	Sitka.
Arizona	R. W. Clothier, Superintendent of Farmers' Institutes.	Tucson.
Arkansas	W. G. Vincenheller, Director Agricultural Experiment Station.	Fayetteville.
California	W. T. Clarke, Superintendent of Farmers' Institutes.	Berkeley.
	J. B. Neff, Conductor of Farmers' Institute in Southern California.	Anaheim.
Colorado	H. M. Cottrell, Director Farmers' Institutes	Fort Collins.
Connecticut	James F. Brown, Secretary State Board of Agriculture.	N. Stonington.
	J. G. Schwink, jr., Secretary Connecticut Dairymen's Association.	Meriden.
	H. C. C. Miles, Secretary Connecticut Pomological Society.	Milford.
Delaware	Wesley Webb, Secretary Board of Agriculture	Dover.
Florida	P. H. Rolfs, Director Agricultural Experiment Station.	Gainesville.
Georgia	A. M. Soule, President State College of Agriculture.	Athens.
Hawaii	J. G. Smith, Agricultural Experiment Station	Honolulu.
Idaho	H. T. French, Director Agricultural Experiment Station.	Moscow.
Illinois	Frank H. Hall, Superintendent Illinois Farmers' Institutes.	Aurora.
Indiana	W. C. Latta, Professor of Agriculture, Purdue University.	Lafayette.
Iowa	J. C. Simpson, Secretary State Board of Agriculture.	Des Moines.
Kansas	J. H. Miller, Superintendent Farmers' Institutes.	Manhattan.
Kentucky	M. C. Rankin, Commissioner of Agriculture	Frankfort.
Louisiana	Charles Schuler, Commissioner of Agriculture	Baton Rouge.

State superintendents—Continued.

State or Territory.	Name of official.	Post-office.
Maine	A. W. Gilman, Commissioner of Agriculture	Augusta.
Maryland	W. L. Amoss, Director of Farmers' Institutes	Benson.
Massachusetts	J. L. Ellsworth, Secretary State Board of Agriculture.	Boston.
Michigan	L. R. Taft, Superintendent of Farmers' Institutes.	Agricultural College.
Minnesota	A. D. Wilson, Director Farmers' Institutes	St. Anthony Park.
Mississippi	E. R. Lloyd, Director of Farmers' Institutes	Agricultural College.
Missouri	Geo. B. Ellis, Secretary State Board of Agriculture.	Columbia.
Montana	F. B. Linfield, Director Agricultural Experiment Station.	Bozeman.
	F. S. Cooley, Deputy Supt. of Farmers' Institutes.	Do.
Nebraska	E. A. Burnett, Director Agricultural Experiment Station.	Lincoln.
	Val. Keyser, Asst. Supt. Farmers' Institutes	Do.
Nevada	J. E. Stubbs, President Nevada State University.	Reno.
New Hampshire	N. J. Bachelder, Secretary State Board of Agriculture.	Concord.
New Jersey	Franklin Dye, Secretary State Board of Agriculture.	Trenton.
New Mexico	J. D. Tinsley, Superintendent Farmers' Institutes.	Agricultural College.
New York	F. E. Dawley, Director Farmers' Institutes	Fayetteville.
North Carolina	Tait Butler, State Veterinarian	Raleigh.
North Dakota	T. A. Hoverstad, Superintendent of Farmers' Institutes.	Fargo.
Ohio	T. L. Calvert, Secretary State Board of Agriculture.	Columbus.
Oklahoma	B. J. Waugh, Secretary State Board of Agriculture.	Guthrie.
Oregon	J. Withycombe, Director Agricultural Experiment Station.	Corvallis.
Pennsylvania	A. L. Martin, Deputy Secretary of Agriculture	Harrisburg.
Porto Rico	D. W. May, Agricultural Experiment Station	Mayaguez.
Rhode Island	John J. Dunn, Secretary State Board of Agriculture.	Providence.
South Carolina	J. N. Harper, Director Agricultural Experiment Station.	Clemson College.
South Dakota	A. E. Chamberlain, Superintendent of Farmers' Institutes.	Brookings.
Tennessee	John Thompson, Commissioner of Agriculture	Nashville.
Texas	J. W. Carson, Director Farmers' Institutes	College Station.
Utah	Lewis A. Merrill, Superintendent of Farmers' Institutes.	501 Security and Trust Building, Salt Lake City.
Vermont	George Aitken, Secretary State Board of Agriculture.	Woodstock.
Virginia	———, Director of Institutes	Blacksburg.
Washington	E. E. Elliott, Washington Agricultural College	Pullman.
West Virginia	J. B. Garvin, Secretary State Board of Agriculture.	Charleston.
Wisconsin	G. B. McKerrow, Director Farmers' Institutes	Madison.
Wyoming	J. D. Towar, Director Agricultural Experiment Station.	Laramie.

AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

President, Tait Butler, State Veterinarian, Raleigh, N. C.; secretary-treasurer, John Hamilton, Farmers' Institute Specialist, U. S. Department of Agriculture, Washington, D. C.

FARMERS' INSTITUTES.

Farmers' institutes were held during the year ended June 30, 1907, in all of the States and Territories excepting Alaska, Nevada, Porto Rico, and Texas. The following table gives a summary of the work for the year:

Statistics of farmers' institutes for season ended June 30, 1907.

State or Territory.	Meetings.					Speakers on State force.	Funds appropriated for institutes.		Report of proceedings.	
	Total.	One day.	Two days or more.	Sessions.	Total attendance.		Year ended June 30, 1907.	Year ended June 30, 1908.	Published.	Copies.
Alabama	24	24	......	33	2,857	12	$600.00	$600.00	No	......
Arizona	20	20	......	20	1,000	3	300.00	......	No	......
Arkansas	40	40	......	41	3,000	6	......	1,500.00	No	......
California	84	33	51	296	20,470	31	6,000.00	6,000.00	Yes	12,500
Colorado	62	44	18	171	16,960	22	5,003.19	5,000.00	No	......
Connecticut	38	37	1	74	9,522	36	2,435.57	400.00	......	......
Delaware	12	5	7	51	9,210	9	700.00	600.00	Yes	5,000
Florida	1	1	......	1	30	20	7.00	5,000.00	No	......
Georgia	......	......	......	......	......	12	2,500.00	......	Yes	3,000
Hawaii	3	1	2	6	500	5	62.05	......	Yes	1,000
Idaho	1	......	1	14	550	12	142.08	1,000.00	No	......
Illinois	111	8	103	589	333,350	107	28,978.96	18,650.00	Yes	20,000
Indiana	281	138	143	996	177,441	35	12,700.00	10,000.00	Yes	1,000
Iowa	85	......	85	340	51,000	14	7,425.00	7,425.00	No	......
Kansas	135	85	50	358	20,200	28	4,064.00	6,300.00	No	......
Kentucky	123	......	123	335	26,836	22	13,000.00	13,000.00	Yes	25,000
Louisiana	10	10	......	10	......	21	2,000.00	2,000.00	......	......
Maine	33	33	......	65	4,771	27	5,000.00	3,000.00	Yes	6,000
Maryland	23	6	17	121	9,833	8	6,000.00	6,000.00	No	......
Massachusetts	126	126	......	155	19,692	66	2,750.00	4,000.00	No	......
Michigan	329	262	67	965	115,136	48	15,500.00	......	Yes	10,000
Minnesota	139	138	1	282	67,063	12	20,665.00	18,000.00	Yes	35,000
Mississippi	148	146	2	296	17,945	19	3,000.00	3,000.00	Yes	10,000
Missouri	212	178	34	372	46,511	26	5,000.00	5,000.00	Yes	10,000
Montana	70	65	5	78	7,541	21	5,000.00	7,500.00	Yes	5,000
Nebraska	136	50	86	442	65,419	33	8,684.04	10,000.00	No	......
New Hampshire	15	14	1	34	3,500	14	1,600.00	2,000.00	Yes	2,000
New Jersey	44	36	8	132	10,399	9	3,060.98	2,500.00	No	......
New Mexico	24	24	......	29	970	11	1,900.00	800.00	No	......
New York	211	80	131	834	105,196	61	20,000.00	25,000.00	Yes	15,000
North Carolina	124	124	......	246	31,980	26	6,500.00	3,750.00	Yes	30,000
North Dakota	25	5	20	99	9,709	8	6,000.00	6,000.00	Yes	10,000
Ohio	299	......	299	1,495	92,303	41	22,000.00	22,000.00	Yes	15,000
Oklahoma	40	18	22	99	6,715	7	550.00	......	No	......
Oregon	58	51	7	148	22,200	14	3,000.00	2,500.00	No	......
Pennsylvania	394	48	346	981	147,895	56	20,500.00	23,000.00	Yes	10,000
Porto Rico[a]	......	......	......	......	......	5	......	......	......	......
Rhode Island	7	7	......	9	600	17	75.00	......	No	......
South Carolina	73	73	......	93	13,219	14	3,000.00	3,000.00	No	......
South Dakota	71	18	53	280	26,000	13	5,000.00	7,000.00	No	......
Tennessee	48	45	3	51	10,400	9	5,000.00	5,000.00	Yes	3,000
Utah[a]	......	......	......	......	......	16	......	......	......	......
Vermont	34	34	......	68	7,288	19	5,000.00	5,000.00	Yes	2,000
Virginia	7	6	1	16	310	11	2,500.00	5,000.00	......	......
Washington	24	20	4	70	5,250	14	......	5,000.00	No	......
West Virginia	110	4	106	373	24,825	31	7,476.71	12,500.00	No	......
Wisconsin	61	......	61	311	49,989	23	12,771.09	20,000.00	Yes	60,000
Wyoming	12	6	6	35	1,292	10	1,000.00	1,051.89	No	......
Total	3,927	2,063	1,864	11,514	1,596,877	1,084	284,450.67	285,076.39	......	290,500

[a] No report received.

STATE OFFICIALS IN CHARGE OF AGRICULTURE.[a]

Commissioners of Agriculture.

State or Territory.	Name of official.	Post-office.
Alabama	J. A. Wilkinson	Montgomery.
Arkansas	Guy B. Tucker	Little Rock.
Florida	B. E. McLin	Tallahassee.
Georgia	T. G. Hudson	Atlanta.
Idaho	Allen Miller, Com'r of Immigration, etc	Boise.
Kentucky	M. C. Rankin	Frankfort.
Louisiana	Charles Schuler	Baton Rouge.
Maine	A. W. Gilman	Augusta.
Montana	J. A. Ferguson	Helena.
New Mexico	Nathan Jaffa, Secretary of State	Santa Fe.
New York	Chas. A. Wieting	Albany.
North Carolina	S. L. Patterson	Raleigh.
North Dakota	W. C. Gilbreath	Bismarck.
Pennsylvania	N. B. Critchfield, Secretary of Agriculture	Harrisburg.
Philippine Islands	G. E. Nesom, Director of Agriculture	Manila.
Porto Rico	Laurance H. Grahame, Commissioner of the Interior	San Juan.
South Carolina	E. J. Watson	Columbia.
Tennessee	John Thompson	Nashville.
Texas	R. T. Milner	Austin.
Virginia	Geo. W. Koiner	Richmond.
Washington	Sam H. Nichols, Secretary of State	Olympia.

Secretaries of State Boards of Agriculture.

State or Territory.	Name of official.	Post-office.
California	J. A. Filcher	Sacramento.
Colorado	A. M. Hawley	Fort Collins.
Connecticut	J. F. Brown	North Stonington.
Delaware	Wesley Webb	Dover.
Hawaii	C. S. Holloway	Honolulu.
Illinois	J. K. Dickinson	Springfield.
Indiana	Chas. Downing	Indianapolis.
Iowa	J. C. Simpson	Des Moines.
Kansas	F. D. Coburn	Topeka.
Kentucky	Perry M. Shy	Frankfort.
Maryland	Wm. T. P. Turpin, Supt. of Immigration	Centerville.
Massachusetts	J. L. Ellsworth	Boston.
Michigan	Addison M. Brown	Agricultural College.
Minnesota	C. N. Cosgrove, Sec. State Ag'l Society	St. Paul.
Missouri	George B. Ellis	Columbia.
Nebraska	W. R. Mellor	Lincoln.
Nevada	Louis Bevier	Carson City.
New Hampshire	N. J. Bachelder	Concord.
New Jersey	Franklin Dye	Trenton.
North Carolina	Elias Carr, Acting Secretary	Raleigh.
Ohio	T. L. Calvert	Columbus.
Oklahoma	Chas. F. Barrett	Guthrie.
Oregon	F. A. Welch	Salem.
Rhode Island	John J. Dunn	Providence.
South Dakota	C. N. McIlvaine	Huron.
Vermont	F. L. Davis	North Pomfret.
West Virginia	J. B. Garvin	Charleston.
Wisconsin	John M. True	Madison.
Wyoming	C. T. Johnston, State Engineer	Cheyenne.

[a] Officials of Territories and island dependencies are included. So far as learned, Arizona, Mississippi, and Utah have no State official charged with agricultural interests, but letters addressed to the Secretary of State would probably receive attention.

NATIONAL DAIRY ASSOCIATIONS.

Name of organization.	Secretary.	Post-office.
International Federation of Dairying.	L. Gedoelst	31 rue Jordan, Brussels, Belgium.
	Ed. H. Webster, chairman American committee.	U. S. Department of Agriculture, Washington, D. C.
International Association of Milk Dealers.	B. D. White	Do.
Association of State and National Food and Dairy Departments.	R. M. Allen	Lexington, Ky.
Association of Inspectors and Instructors of the National and State Dairy and Food Departments.	B. D. White	U. S. Department of Agriculture, Washington, D. C.
National Association of Dairy Instructors and Investigators.	C. B. Lane	Do.
National Dairy Union	Chas. Y. Knight	154 Lake st., Chicago, Ill.
National Dairy Show Association	E. Sudendorf	154 Washington st., Chicago, Ill.
National Creamery Buttermakers' Association.	S. B. Shilling	154 Lake st., Chicago, Ill.

AMERICAN NATIONAL LIVE STOCK ASSOCIATION.

President, H. A. Jastro, Bakersfield, Cal.; secretary, W. M. Tomlinson, Denver, Colo.

AMERICAN ASSOCIATION OF LIVE STOCK HERD BOOK SECRETARIES.

President, C. R. Thomas, Kansas City, Mo.; secretary, Charles F. Mills, Springfield, Ill.

NATIONAL WOOL GROWERS' ASSOCIATION.

President, F. R. Gooding, Boise, Idaho; secretary, George S. Walker, Cheyenne, Wyo.

THE CORN-BELT MEAT PRODUCERS' ASSOCIATION.

President, A. L. Ames, Buckingham, Iowa; secretary, H. C. Wallace, Des Moines, Iowa.

PROTECTION AGAINST CONTAGION FROM FOREIGN CATTLE.

An act of Congress of August 28, 1894, prohibits the importation of cattle and cattle hides, but by the act of March 2, 1895, making appropriations for the Department of Agriculture, it is provided that the prohibition may be suspended by the President whenever the Secretary of Agriculture shall certify to the President what countries or parts of countries are free from contagious or infectious diseases of domestic animals. The President, by proclamation of November 8, 1895, lifted the embargo with reference to Norway, Sweden, Holland, Great Britain, Ireland, the Channel Islands, and the countries of North, Central, and South America so as to admit cattle under sanitary regulations prescribed by the Secretary of Agriculture; also from all countries so as to admit hides under regulations prescribed by the Secretary of the Treasury.

STOCK BREEDERS' ASSOCIATIONS.[a]

Names and addresses of stock breeders' association secretaries, with breeds and numbers of registered live stock in United States, June 30, 1907.

CATTLE.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Males.	Females.	Males.	Females.
Aberdeen Angus	Chas. Gray	Union Stock Yards, Chicago, Ill.	36,372	59,020	31,757	40,419
Ayrshire	C. M. Winslow	Brandon, Vt.	10,310	22,095	1,286	7,020
Devon	L. P. Sisson	Newark, Ohio	8,281	14,094	4,000	10,000
Dutch Belted	H. P Richards	Easton, Pa.	649	1,385	175	500
Galloway	R. W. Brown	Union Stock Yards, Chicago, Ill.	17,946	12,754	7,000	10,100
Guernsey	Wm. H. Caldwell	Peterboro, N. H.	12,174	22,678	8,000	14,000
Hereford	C. R. Thomas	225 W. 12th st., Kansas City, Mo.	133,021	135,862	[b] 115,000	
Holstein-Friesian	F. L. Houghton	Brattleboro, Vt.	50,871	104,846	(c)	(c)
Jersey	J. J. Hemingway	8 W. 17th st., New York City.	76,817	207,453	(c)	(c)
Polled Durham	J. H. Martz	Greenville, Ohio	6,615	7,957	4,505	5,631
Red Polled	H. A. Martin	Gotham, Wis.	16,366	27,148	6,500	13,500
Shorthorn	John W. Groves	Union Stock Yards, Chicago, Ill.	282,000	432,903	93,000	186,000
Sussex	Overton Lea	Nashville, Tenn	85	188	68	108
Swiss, Brown	C. D. Nixon	Owego, N. Y	2,424	3,572	(c)	(c)

HORSES.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Males.	Females.	Males.	Females.
Cleveland Bay	R. P. Stericker	80 Chestnut ave., West Orange, N. J.	1,262	520	1,200	450
Clydesdale	R. B. Ogilvie	Union Stock Yards, Chicago, Ill.	[b] 13,236		(c)	(c)
Coach, French	Chas. C. Glenn	Columbus, Ohio	276	6	268	6
Do	Duncan E. Willet	Maple ave. and Harrison st., Oak Park, Ill.			1,500	500
Coach, German	J. Crouch	Lafayette, Ind	2,149	290	1,900	250
Coach, German (Oldenburg).	C. E. Stubbs	Fairfield, Iowa	275	23	240	25
Draft, Belgian	J. D. Connor, jr	Wabash, Ind	2,740	395	2,800	425
Draft, French	C. E. Stubbs	Fairfield, Iowa	10,071	5,942	6,000	5,500
Hackney	Gurney C. Gue	Tichenor Grand Bldg., 61st st. and Broadway, New York City.			622	1,176
Morgan	T. E. Boyce	Middlebury, Vt			2,000	2,000
Percheron	Geo. W. Stubblefield	Union Stock Yards, Chicago, Ill.	5,022	4,614	21,500	14,000
Do	Chas. C. Glenn	Columbus, Ohio	1,787	413	1,762	393
Do	John A. Forney	Plainfield, Ohio.			21,000	13,000
Saddle Horse	I. B. Nall	Louisville, Ky	2,890	4,126	2,166	3,096
Shetland Pony	Mortimer Levering	Lafayette, Ind	2,500	3,800	3,000	3,500
Shire	Chas. Burgess	Wenona, Ill	6,652	2,482	2,375	625
Suffolk	Alex. Galbraith	Janesville, Wis	194	128	120	100
Thoroughbred	W. H. Rowe	571 5th ave., New York City.	[b] 49,706		(c)	(c)
Trotter, American	W. H. Knight	355 Dearborn st., Chicago, Ill.	46,170	159,845	25,000	50,000
Jacks and Jennets	J. W. Jones	Columbia, Tenn	1,436	900	(c)	(c)

[a] Under the provisions of paragraph 473 of the act of July 24, 1897, amended March 3, 1903, any animal imported specially for breeding purposes shall be admitted free provided that no such animal shall be admitted free unless pure bred, of a recognized breed, and duly registered in the book of record established for that breed. The Secretary of the Treasury, upon the advice of the Secretary of Agriculture, issued, July 11, 1906, regulations for the importation of animals under this law, and designated the recognized breeds and the books of record established for these breeds.

[b] Total of males and females.

[c] No data.

Names and addresses of stock breeders' association secretaries, with breeds and numbers of registered live stock in United States, June 30, 1907—Continued.

SHEEP.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Males.	Females.	Males.	Females.
Cheviot	F. E. Dawley	Fayetteville, N. Y.	a 11,410		625	3,150
Cotswold	F. W. Harding	Waukesha, Wis.	a 43,790		a 16,000	
Dorset Horn	J. E. Wing	Mechanicsburg, Ohio	1,815	4,711	1,200	3,000
Hampshire Down	Comfort A. Tyler	Nottawa, Mich.	6,540	14,694	2,500	8,000
Leicester	A. J. Temple	Cameron, Ill.	4,068	6,344	3,417	5,328
Lincoln	Bert Smith	Charlotte, Mich.	6,660	9,550	4,800	6,800
Merino (Delaine)	Beulah M. McDowell	Canton, Ohio	a 10,494		a 8,000	
Do	J. B. Johnson	248 W. Pike st., Canonsburg, Pa.	6,973	11,893	500	2,000
Merino (French)	Dwight Lincoln	Milford Center, Ohio	a 41,975		15,000	25,000
Merino (German)	E. N. Ball	Ann Arbor, Mich.	197	256	158	194
Merino (Spanish)	do	do	12,575	37,775	1,000	5,000
Do	J. H. Earll	Skaneateles, N. Y.	7,960	11,957	90	630
Do	Wesley Bishop	R. F. D. No. 1, Delaware, Ohio.	17,496	34,715	3,200	7,986
Do	J. P. Ray	R. F. D. No. 3, East Bloomfield, N. Y.	1,275	1,500	60	240
Do	C. A. Chapman	Middlebury, Vt.	a 218,265		(b)	(b)
Oxford Down	W. A. Shafor	Hamilton, Ohio	a 38,353		(b)	(b)
Shropshire	Mortimer Levering	Lafayette, Ind.	112,000	154,000	50,000	90,000
Southdown	Frank S. Springer	Springfield, Ill.	a 21,742		a 10,000	
Suffolk	Geo. W. Franklin	Des Moines, Iowa	a 1,143		300	330

HOGS.

Breed.	Secretary.	Post-office.	Males.	Females.	Males.	Females.
Berkshire	Frank S. Springer	Springfield, Ill.	a 102,040		a 50,000	
Cheshire	Ed. S. Hill	Freeville, N. Y.	1,291	2,728	300	1,000
Chester (Ohio Improved.)	J. C. Hiles	Cleveland, Ohio	a 18,203		7,500	22,500
Duroc Jersey	T. B. Pearson	Thorntown, Ind.	10,183	23,530	9,000	18,430
Do	H. C. Sheldon	Peoria, Ill.	32,010	77,500	25,000	75,000
Hampshire (Thin Rind.)	E. C. Stone	Armstrong, Ill.	645	1,783	440	1,690
Poland China	W. M. McFadden	Union Stock Yards, Chicago, Ill.	63,269	156,955	40,000	16,000
Do	A. M. Brown	Drawer 16, Winchester, Ind.	35,000	78,000	35,000	65,000
Do	Geo. F. Woodworth	Maryville, Mo.	45,675	110,060	3,000	12,000
Do	H. P. Wilson	Gadsden, Tenn.	897	1,316	400	700
Tamworth	E. N. Ball	Ann Arbor, Mich.	a 3,150		500	2,500
Yorkshire	Harry G. Krum	White Bear Lake, Minn.	a 6,500		1,200	3,000

a Total of males and females. b No data.

SANITARY OFFICERS IN CHARGE OF LIVE STOCK INTERESTS.

State or Territory.	Name and post-office.	Official position.
Alabama	C. A. Cary, Auburn	State veterinarian.
Arizona	J. D. Carter, Prescott	Secretary live-stock sanitary commission.
	J. C. Norton, Phoenix	Veterinarian.
Arkansas	R. R. Dinwiddie, Fayetteville	State veterinarian.
California	Charles Keane, Sacramento	Do.
Colorado	L. B. Sylvester, Denver	President State board of stock inspection commissioners.
	Charles G. Lamb, Denver	State veterinary surgeon.
Connecticut	Heman O. Averill, Hartford	Commissioner for domestic animals.
Delaware	Alex. Lowber, Wilmington	Secretary State board of health.
	H. P. Eves, Newark	Instructor in veterinary science, Delaware College.
Florida	Thos. J. Mahaffy, Jacksonville	Veterinarian State board of health.
Georgia	Thos. G. Hudson, Atlanta	Commissioner of agriculture.
Hawaii	V. A. Nörgaard, Honolulu	Territorial veterinarian.
Idaho	Geo. E. Noble, Boise	State veterinarian.
Illinois	H. E. Wadsworth, Springfield	Secretary board of live-stock commissioners.
	J. M. Wright, 1827 Wabash avenue, Chicago.	State veterinarian.

Sanitary officers in charge of live stock interests—Continued.

State or Territory.	Name and post-office.	Official position.
Indiana	A. W. Bitting, Lafayette	State veterinarian.
Iowa	Paul O. Koto, Des Moines	State veterinary surgeon.
Kansas	F. S. Schoenleber, Manhattan	Veterinarian, experiment station.
	John D. Baker, Peabody	Live stock sanitary commissioner.
Kentucky	F. T. Eisenman, Louisville	State veterinarian.
Louisiana	W. H. Dalrymple, Baton Rouge	Veterinarian, State experiment station.
Maine	F. O. Beal, Bangor J. M. Deering, Saco F. S. Adams, Bowdoinham	Board of cattle commissioners.
Maryland	G. Allen Jarman, Chestertown	Chief veterinary inspector.
	Wade H. D. Warfield, Baltimore	Secretary live-stock sanitary board.
Massachusetts	Austin Peters, State House, Boston	Chief of cattle bureau, State board of agriculture.
Michigan	W. M. Morris, Cass City	State veterinarian.
	H. H. Hinds, Stanton	President State live-stock sanitary commission.
	Comfort A. Tyler, Nottawa	Secretary State live-stock sanitary commission.
Minnesota	M. H. Whitcomb, St. Paul	Secretary State live-stock sanitary board.
	C. E. Cotton, Minneapolis	Veterinarian live-stock sanitary board.
	H. M. Bracken, St. Paul	Secretary State board of health.
Mississippi	J. C. Robert, Agricultural College	Professor of veterinary science.
Missouri	D. F. Luckey, Columbia	State veterinarian.
	Geo. B. Ellis, Columbia	Secretary State board of agriculture.
Montana	M. E. Knowles, Helena	State veterinarian.
	W. G. Preuitt, Helena	Secretary live-stock commission.
Nebraska	Chas. A. McKimm, Lincoln	State veterinarian.
Nevada	I. W. O'Rourke, Reno	Do.
New Hampshire	N. J. Bachelder, Concord	Secretary board of cattle commissioners.
New Jersey	E. B. Voorhees, New Brunswick	President State board of agriculture.
	Franklin Dye, Trenton	Secretary commission on tuberculosis in animals.
New Mexico	W. C. Barnes, Las Vegas	Secretary cattle sanitary board.
	Harry F. Lee, Albuquerque	Secretary sheep sanitary board.
New York	Harry D. Gill, 154 East 57th st., New York City.	State veterinarian for eastern district of New York.
	C. A. Wieting, Cobleskill	Commissioner department of agriculture.
	W. H. Kelly, Albany	Chief veterinarian.
North Carolina	Tait Butler, Raleigh	State veterinarian.
	S. L. Patterson, Raleigh	Commissioner of agriculture.
North Dakota	W. F. Crewe, Devils Lake	State veterinarian.
Ohio	Paul Fischer, Columbus	Do.
	T. L. Calvert, Columbus	Secretary State live-stock commission.
Oklahoma	C. J. Davis, Guthrie	State veterinarian.
	Thomas Morris, Guthrie	Secretary live-stock sanitary commission.
Oregon	C. J. Korinek, Salem	State veterinarian.
	W. H. Lytle, Pendleton	Sheep inspector.
Pennsylvania	Leonard Pearson, Logan Hall, University of Pennsylvania, Philadelphia.	State veterinarian.
Porto Rico	Thos. A. Allen, San Juan	Veterinary inspector, health office.
Rhode Island	John S. Pollard, Providence	Veterinarian State board of agriculture.
	John J. Dunn, Providence	Secretary State board of agriculture.
South Carolina	M. Ray Powers, Clemson College	State veterinarian.
South Dakota	Thos. H. Hicks, Milbank	Do.
Tennessee	W. H. Dunn, Gallatin	State live-stock commissioner.
	John Thompson, Nashville	Commissioner of agriculture.
Utah	T. B. Beatty, Salt Lake City	Secretary State board of health.
	John Austin, Heber City	President State board of sheep commissioners.
Texas	J. H. Wilson, Quanah	Secretary live-stock sanitary commission.
	W. G. Langley, 231 Main st., Dallas	State veterinarian.
Vermont	H. S. Willson, Arlington	Cattle commissioner.
Virginia	J. G. Ferneyhough, Blacksburg	State veterinarian.
Washington	S. B. Nelson, Pullman	Do.
West Virginia	J. B. Garvin, Charleston	Secretary board of agriculture.
Wisconsin	John M. True, Madison	Secretary State sanitary board.
	H. L. Russell, College of Agriculture, Madison.	Director State Experiment Station.
Wyoming	Wm. F. Pflaeging, Cheyenne	State veterinarian.
	Geo. S. Walker, Cheyenne	Secretary State board sheep commissioners.

FORESTRY ASSOCIATIONS.

American Forestry Association.—President, Hon. James Wilson, Secretary of Agriculture; secretary, Thomas E. Will, Washington, D. C.; treasurer, Otto Luebkert, Washington, D. C.

International Society of Arboriculture.—President, Gen. William J. Palmer, Colorado Springs, Colo.; vice-president, Henry John Elwes, F. R. S., Colesborne, Cheltenham, England; secretary, J. P. Brown, Connersville, Ind.

Society of American Foresters.—President, Gifford Pinchot, Washington, D. C.; secretary, W. F. Sherfesee, Washington, D. C.

State organizations.

Name of organization.	Secretary.	Address.
Appalachian Mountain Club	R. B. Lawrence	Tremont Bldg., Boston.
Arizona Salt River Valley Water Users' Association.	Chas. A. Van der Veer	Phoenix, Ariz.
California:		
Water and Forest Association	T. C. Friedlander	45 Mills Bldg., San Francisco.
Forestry Educational Association	E. C. Damon	San Diego.
Sierra Club	William E. Colby	San Francisco.
Forest and Water Society of Southern California.	Wm. H. Knight	Los Angeles.
Pacific Coast Forest, Fish, and Game Association.	Wm. Greer Harrison	San Francisco.
Cincinnati Forest and Improvement Association.	Adolph Leue	127 West Twelfth st.
Colorado Forestry Association	W. G. M. Stone, president	Denver.
Connecticut Forestry Association	Miss Mary Winslow	Weatogue.
Georgia Forestry Association	Alrfed Akerman	Athens.
Iowa Park and Forestry Association	Wesley Greene	Des Moines.
Maine Forestry Association	E. E. Ring	Augusta.
Massachusetts Forestry Association	Edwin A. Start	4 Joy st., Boston.
Michigan Forestry Association	J. Fred Baker	East Lansing.
Minnesota State Forest Association	E. G. Cheyney	St. Anthony Park.
Nebraska Park and Forestry Association	L. B. Craig	York.
New England Forest, Fish, and Game Association.	Walter L. Hill	Pierce Building, Boston.
New Hampshire Society for the Protection of New Hampshire Forests.	Allen Hollis	Concord.
New York:		
State Fish, Game, and Forest League	John D. Whish	Capitol, Albany.
Forestry, Water Storage, and Manufacturing Association of the State of New York.	John C. Durgin	1 Broadway, New York.
Association for the Protection of the Adirondacks.	E. H. Hall	Tribune Bldg., New York.
Northern New York Forestry Association.	O. B. Tappan, director	Potsdam.
American Forest Preservation Society	George Milroy Bailey	Corfu, N. Y.
North Dakota State Sylvaton Society	Miss Ella J. Mitchell	Penn, N. Dak.
Ohio State Forestry Society	C. W. Waid	Wooster.
Oregon Forestry Association	A. D. Monteith	Portland.
Pennsylvania Forestry Association	F. L. Bitler	1012 Walnut st., Philadelphia, Pa.
Pennsylvania Franklin Forestry Society	W G. Bowers	Chambersburg.
Vermont Forestry Association	Ernest Hitchkock	Pittsford.
Washington Forestry Association	Edmund S. Meany	Seattle.
West Virginia Forestry Association	A. W. Nolan	Morgantown.

SCHOOLS OF FORESTRY.

Post-Graduate Schools.

Yale University, Forest School, New Haven, Conn.—A two years' post-graduate course, leading to the degree of Master of Forestry. Under the direction of the officers of the Yale Forest School, a two months' summer course, July and August, is conducted at Milford, Pike County, Pa. Prof. Henry S. Graves, Director.

University of Michigan, Forest School (part of the general Department of Literature, Science, and the Arts), Ann Arbor, Mich.—A two years' post graduate course, leading to the degree of Master of Science in Forestry. A six weeks' summer course, in July and August, is conducted on the State reserve at Roscommon. Prof. Filibert Roth, Professor of Forestry.

Harvard University, Forest School, Cambridge, Mass.—A two years' graduate course, in connection with the Graduate School of Applied Science. Prof. R. T. Fisher, in charge of curriculum.

Undergraduate Schools.

Biltmore Forest School, Biltmore, N. C.—Course covers one full year, leading to the degree of Bachelor of Forestry, and, with two years of practical forest work, the degree of Forest Engineer. Dr. C. A. Schenck, Director.

University of Minnesota, School of Forestry, St. Anthony Park, Minn.—A four years' undergraduate course, leading to the degree of Bachelor of Science in Forestry. A six weeks' summer course, in July and August, is conducted at the Itasca State Forest. Prof. Samuel B. Green, Professor of Forestry.

University of Nebraska, Department of Forestry, Lincoln, Nebr.—A four years' undergraduate course, leading to the degree of Bachelor of Science. Frank J. Phillips, Professor of Forestry.

Michigan State Agricultural College, Department of Forestry, East Lansing, Mich.—A four years' undergraduate course, leading to the degree of Bachelor of Science. J. Fred Baker, Professor of Forestry.

Pennsylvania State College, Forest School, State College, Pa.—A four years' undergraduate course, in connection with the State Department of Agriculture, leading to the degree of Bachelor of Science. Hugh P. Baker, Professor of Forestry.

University of Washington, School of Forestry, Seattle, Wash.—A four years' undergraduate course leading to the degree of Bachelor of Science in Forestry. Frank J. Miller, Professor of Forestry.

University of Georgia, Department of Forestry, Athens, Ga.—A four years' undergraduate course, leading to the degree of Bachelor of Science in Forestry. Alfred Akerman, Professor of Forestry.

Colorado School of Forestry, Colorado Springs, Colo.—A three years' undergraduate course, leading to the degree of Bachelor of Forestry. No entrance requirements. A summer course is conducted at Manitou Park from July 15 to September 15.

The Mont Alto Forest Academy, Mont Alto, Pa.—Maintained by the Pennsylvania Department of Forestry for the training of young men of the State for work on the State forest reserves. Geo. H. Wirt and J. P. Wentling, in charge of forest courses.

Courses in forestry are now given at the University of Maine, Orono, Me., Gordon E. Tower, in charge; Iowa State College, Ames, Iowa, Chas. A. Scott, in charge; Mississippi Agricultural and Mechanical College, Agricultural College, Miss., Geo. L. Clothier, in charge; Purdue University, Lafayette, Ind., Prof. John M. Coulter, in charge; Berea College, Berea, Ky., W. L. Flanery, in charge; State College of Washington, Pullman, Wash., E. O. Siecke, in charge; Winona Agricultural Institute, Winona Lake, Ind., W. R. Eastman, in charge; North Dakota School of Forestry, Bottineau, N. Dak., J. Allen Kemp, president.

A course of lectures is given annually at the Massachusetts State Agricultural College, Amherst, by Prof. Frank Wm. Rane, State Forester of Massachusetts; at the Maryland Agricultural College, College Park, by Fred W. Besley, State Forester of Maryland; at the University of Wisconsin, Madison, by Edward M. Griffith, State Forester of Wisconsin; at the Agricultural College of Utah, Logan, by W. W. Clark; at the Connecticut Agricultural College, Storrs; and at the State Agricultural College of Colorado, Fort Collins.

STATE FOREST OFFICERS.

State or Territory.	Name and post-office.	Official position.
Alabama	John Wallace, jr., Montgomery	Secretary, State forest commission.
California	Gerard B. Lull, Sacramento	State forester.
Connecticut	Austin F. Hawes, New Haven	Do.
Hawaii	Ralph S. Hosmer	Superintendent of forestry.
Indiana	W. H. Freeman, Indianapolis	Secretary, State board of forestry.
Kansas	Henry Cooper, Dodge City	Commissioner of forestry.
	F. H. Ridgway, Ogallah	Do.
Kentucky	Hubert Vreeland, Frankfort	Chairman, State board of agriculture, forestry, and immigration.
Louisiana	A. W. Crandell, Baton Rouge	State forest commissioner.
Maine	Edgar E. Ring, Augusta	Land agent and forest commissioner.
Massachusetts	F. Wm. Rane, Boston	State forester.
Maryland	F. W. Besley, Baltimore	Do.
Michigan	Wm. H. Rose, Lansing	Secretary, forestry commission.
	Filibert Roth, Ann Arbor	State forest warden.
Minnesota	Gen. C. C. Andrews, St. Paul	Secretary, State forestry board, and forestry commissioner.
Mississippi	A. F. Crider, Biloxi	Director, State geological survey.
New Hampshire	R. E. Faulkner, Keene	Secretary, forest commission.
New Jersey	Alfred Gaskill, Trenton	Secretary, forest park reservation commission, and forester.
New York	Wm. H. Fox, Albany	Superintendent of State forests.
	C. R. Pettis	Forester.

State forest officers—Continued.

State or Territory.	Name and post-office.	Official position.
North Carolina	Joseph H. Pratt, Chapel Hill	State geologist.
Ohio	Charles E. Thorne, Wooster	Director, State agricultural experiment station.
Oregon	J. W. Baker, Cottage Grove	Forestry, fish, and game warden.
	E. P. Sheldon, Portland	Secretary, forestry commission.
Pennsylvania	Robert S. Conklin, Harrisburg	Commissioner of forestry.
	George H. Wirt, Harrisburg	State forester.
	J. P. Wentling, Mont Alto	Forester.
Rhode Island	Jesse D. Mowry, Chepatchet	Commissioner of forestry.
Tennessee	C. A. Keffer, Knoxville	Secretary, Tennessee forest commission.
Vermont	Arthur M. Vaughn, Randolph	Commissioner of forestry.
Washington	R. W. Condon, Port Gamble	Chairman, department of forestry.
	J. R. Welty, Olympia	State fire warden and forester.
West Virginia	I. C. White, Morgantown	Superintendent, geologic and economic survey.
Wisconsin	Edward M. Griffith, Madison	State forester.

NATIONAL BEE KEEPERS' ASSOCIATION.

President, Geo. Hilton, Fremont, Mich.; secretary, W. Z. Hutchinson, Flint, Mich.; general manager and treasurer, N. E. France, Platteville, Wis.

NATIONAL ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

President, S. A. Forbes, Urbana, Ill.; secretary, A. F. Burgess, Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

President, Harry Snyder, St. Anthony Park, Minn.; secretary, H. W. Wiley, chemist, Department of Agriculture, Washington, D. C.

HORTICULTURAL AND KINDRED SOCIETIES.

Name of organization.	Secretary.	Post-office.
American Apple Growers' Congress	T. C. Wilson	Hannibal, Mo.
American Association of Nurserymen	Geo. C. Seager	Rochester, N. Y.
American Carnation Society	Albert M. Herr	Lancaster, Pa.
American Cranberry Growers' Association	A. J. Rider	Hammonton, N. J.
American Federation of Horticultural Societies.	Chas. E. Bassett	Fennville, Mich.
American Institute, Horticultural Section	Leonard Barron	19 W. 44th st., New York, N. Y.
American Nurserymen's Protective Association.	Thos. B. Meehan	Dreshertown, Pa.
American Pomological Society	John Craig	Ithaca, N. Y.
American Retail Nurserymen's Protective Association.	Guy A. Bryant	Princeton, Ill.
American Rose Society	Benjamin Hammond	Fishkill on Hudson, N. Y.
Chrysanthemum Society of America	David Fraser	Pittsburg, Pa.
Cider and Cider Vinegar Makers' Association of the Northwest.	George Miltenberger	St. Louis, Mo.
Eastern Nurserymen's Association	Wm. Pitkin	Rochester, N. Y.
International Apple Shippers' Association	A. Warren Patch	Boston, Mass.
Mississippi Valley Apple Growers' Association.	James Handly	Quincy, Ill.
Missouri Valley Horticultural Society	A. V. Wilson	Muncie, Kans.
National Association of Retail Nurserymen	F. E. Grover	Rochester, N. Y.
National Council of Horticulture	H. C. Irish	Missouri Botanical Garden, St. Louis, Mo.
National League of Commission Merchants of the United States.	A. Warren Patch	Boston, Mass.
National Nut Growers' Association	J. F. Wilson	Poulan, Ga.
Northwestern Fruit Growers' Association	C. D. Huffman	La Grande, Oreg.
Nurserymen's Mutual Protective Association.	Geo. C. Seager	Rochester, N. Y.
Pacific Coast Association of Nurserymen	C. A. Tonneson	Tacoma, Wash.
Peninsula Horticultural Society	Wesley Webb	Dover, Del.
Society for Horticultural Science	C. P. Close	College Park, Md.
Society of American Florists and Ornamental Horticulturists.	P. J. Hauswirth	Chicago, Ill.
Southern Nurserymen's Association	A. I. Smith	Knoxville, Tenn.
Southwestern Nurserymen's Association	J. A. Taylor	Wynnewood, Okla.
Western Association of Nurserymen	E. J. Holman	Leavenworth, Kans.
Western Fruit Jobbers' Association	E. B. Branch	Omaha, Nebr.

STATE HIGHWAY OFFICIALS.

State.	Name and title.	Post-office.
California	N. Ellery, State engineer, department of engineering.	Sacramento.
Connecticut	James H. MacDonald, commissioner, State highway department.	Hartford.
Colorado	T. W. Jaycox, State engineer	Denver.
Delaware	Francis A. Price, State highway commissioner, Newcastle County.	Dover.
District of Columbia	C. B. Hunt, engineer of highways	Washington, D. C.
Idaho	James Stephenson, jr., State engineer	Boise.
Illinois	Dr. E. J. James, chairman, State highway commission.	Springfield.
	A. N. Johnson, highway engineer, State highway commission.	Do.
Iowa	Prof. A. Marston, dean, division of engineering.	Ames.
	T. H. McDonald, assistant in charge public roads, State College.	Do.
Maine	Paul D. Sargent, commissioner of highways	Augusta.
Maryland	Wm. Bullock Clark, State geologist	Baltimore.
	Walter W. Crosby, chief engineer, highway division, geological survey.	Do.
Massachusetts	William E. McClintock, chairman, State highway commission.	Boston.
	A. B. Fletcher, secretary, State highway commission.	Do.
Michigan	Horatio S. Earle, commissioner, State highway department.	Lansing.
	Frank F. Rodgers, highway engineer	Do.
Minnesota	Gustav Scholle, president, State highway commission.	Minneapolis.
	George W. Cooley, engineer, State highway commission.	Do.
Missouri	Curtis Hill, State highway engineer	Columbia.
New Hampshire	Arthur W. Dean, State engineer, highway department.	Concord.
New Jersey	Frederick Gilkyson, commissioner of public roads.	Trenton.
	R. A. Meeker, supervisor, State commission of public roads.	Do.
New York	Frederick Skene, State engineer and surveyor	Albany.
North Carolina	Samuel L. Patterson, chairman, State highway commission.	Raleigh.
Ohio	Sam Huston, commissioner, State highway department.	Columbus.
Pennsylvania	Joseph W. Hunter, State highway commissioner.	Harrisburg.
	R. D. Beman, assistant commissioner	Do.
Rhode Island	John H. Edwards, chairman, State board of public roads.	Providence.
Vermont	Charles W. Gates, State highway commissioner.	Montpelier.
Virginia	P. St. Julien Wilson, State highway commissioner.	Richmond.
Washington	Joseph M. Snow, highway commissioner	Olympia.
West Virginia	H. E. Williams, State highway inspector	Charleston.
Wisconsin	W. O. Hotchkiss, chief highway division, State geological survey.	Madison.

STATE OFFICIALS IN CHARGE OF PROTECTION OF GAME.

State	Name and title.	Post-office.
Alabama	John H. Wallace, jr., State game and fish commissioner.	Montgomery.
Arizona	W. L. Pinney, secretary, fish and game commission.	Phoenix.
California	Chas. A. Vogelsang, chief deputy, board of fish commissioners.	San Francisco.
Colorado	David E. Farr, State game and fish commissioner.	Denver.
Connecticut	E. Hart Geer, secretary, commission of fisheries and game.	Hadlyme.
Delaware	A. D. Poole, president, Delaware Game Protective Association.	Wilmington.
District of Columbia	Maj. Richard Sylvester, superintendent metropolitan police.	Washington.
Idaho	Wm. N. Stephens, fish and game warden	Rexburg.
Illinois	Dr. John A. Wheeler, State game commissioner	Springfield.
Indiana	Z. T. Sweeney, commissioner of fisheries and game.	Columbus.

State officials in charge of protection of game—Continued.

State.	Name and title.	Post-office.
Iowa	G. A. Lincoln, State fish and game warden	Cedar Rapids.
Kansas	D. W. Travis, State fish and game warden	Pratt.
Maine	L. T. Carleton, chairman, commission of inland fisheries and game.	Augusta.
Maryland	Horace F. Harmonson, State game warden	Berlin.
Massachusetts	Dr. George W. Field, chairman, commission of fisheries and game.	Boston.
Michigan	Charles S. Pierce, game and fish warden	Lansing.
Minnesota	Carlos Avery, executive agent, board of game and fish commissioners.	St. Paul.
Missouri	James C. Bassford, game and fish warden	Mexico.
Montana	William F. Scott, State game and fish warden	Helena.
Nebraska	George L. Carter, chief deputy, game and fish commission.	Lincoln.
New Hampshire	Nathaniel Wentworth, chairman, board of fish and game commissioners.	Hudson.
New Jersey	Benedict C. Kuser, president, board of fish and game commissioners.	Trenton.
New Mexico	W. E. Griffin, game and fish warden	Santa Fe.
New York	James S. Whipple, forest, fish, and game commissioner.	Albany.
North Carolina	T. Gilbert Pearson, secretary Audubon Society.	Greensboro.
North Dakota	W. N. Smith, game warden district No. 1	Grafton.
	Olaf Bjorke, game warden district No. 2	Abercrombie.
Ohio	Gen. John C. Speaks, chief warden	Columbus.
Oklahoma	Eugene Watrous, State game and fish warden	Enid.
Oregon	J. W. Baker, game and forestry warden	Cottage Grove.
Pennsylvania	Dr. Joseph Kalbfus, secretary, board of game commissioners.	Harrisburg.
Rhode Island	John H. Flanagan, chairman, commission of birds.	Providence.
South Carolina	B. F. Taylor, president, Audubon Society	Columbia.
Tennessee	Joseph H. Acklen, State warden of game, fish, and forestry.	Nashville.
Texas	R. W. Lorance, chief deputy game, fish, and oyster commissioner.	Austin.
Utah	H. B. Cromar, State fish and game commissioner	Salt Lake City.
Vermont	Henry G. Thomas, fish and game commissioner.	Stowe.
Washington	R. C. Bebee, chief deputy State game warden	Bellingham.
West Virginia	F. H. Merrick, chief deputy game and fish warden	Huntington.
Wisconsin	J. W. Stone, State warden	Madison.
Wyoming	D. C. Nowlin, State game warden	Lander.

ORGANIZATIONS FOR PROTECTION OF BIRDS AND GAME.

Name of organization.	Secretary.	Post-office.
American Ornithologists' Union, Committee on Protection of North American Birds.	A. K. Fisher, chairman	Department of Agriculture, Washington, D. C.
Bird Protective Society of America	Edward C. Pease	28 Stafford Bldg., Buffalo, N. Y.
Boone and Crockett Club	Madison Grant	11 Wall st., New York, N.Y.
Forest, Fish, and Game Society of America.	Wm. F. Kimber	509 5th ave., New York City, N. Y.
League of American Sportsmen	Arthur F. Rice	949 Broadway, New York, N. Y.
Lewis and Clark Club	J. Bissell Speer	345 4th ave., Pittsburg, Pa.
National Association of Game and Fish Wardens.	Chas. A. Vogelsang	Merchants' Exchange Bldg., San Francisco, Cal.
National Association of Audubon Societies.	Wm. Dutcher, president	141 Broadway, New York, N. Y.
New York Zoological Society	Madison Grant	11 Wall st., New York, N. Y.
North American Fish and Game Protective Association.	E. T. D. Chambers	Quebec, Canada.

OFFICIAL INSPECTORS OF FERTILIZERS IN THE UNITED STATES.

State.	Official title.	Post-office.
Alabama	Commissioner of agriculture	Montgomery.
Arkansas	Commissioner of mines, manufactures, and agriculture.	Little Rock.
California	Director, agricultural experiment station	Berkeley.
Connecticut	do	New Haven.
Delaware	State chemist, agricultural experiment station	Newark.
Florida	Commissioner of agriculture	Tallahassee.
Georgia	do	Atlanta.
Illinois	Secretary, State board of agriculture	Springfield.
Indiana	State chemist, Purdue University	Lafayette.
Kansas	Director, agricultural experiment station	Manhattan.
Kentucky	do	Lexington.
Louisiana	Commissioner of agriculture and immigration	Baton Rouge.
Maine	Director, agricultural experiment station	Orono.
Maryland	State chemist, Maryland Agricultural College	College Park.
Massachusetts	Director, agricultural experiment station	Amherst.
Michigan	Secretary, State board of agriculture	East Lansing.
Mississippi	State chemist	Agricultural College.
Missouri	Director, agricultural experiment station	Columbia.
New Hampshire	Secretary, State board of agriculture	Concord.
New Jersey	Director, agricultural experiment stations	New Brunswick.
New York	Commissioner of agriculture	Albany.
North Carolina	do	Raleigh.
North Dakota	Director, agricultural experiment station	Fargo.
Ohio	Secretary, State board of agriculture	Columbus.
Oklahoma	do	Guthrie.
Pennsylvania	Secretary of agriculture	Harrisburg.
Porto Rico	Commissioner of the interior	San Juan.
Rhode Island	Chemist, agricultural experiment station	Kingston.
South Carolina	Secretary, board of control	Clemson College.
Tennessee	Commissioner of agriculture	Nashville.
Texas	State chemist	College Station.
Vermont	Director, agricultural experiment station	Burlington.
Virginia	Commissioner of agriculture	Richmond.
Washington	State chemist, State College	Pullman.
West Virginia	Director, agricultural experiment station	Morgantown.
Wisconsin	do	Madison.

AMERICAN BREEDERS' ASSOCIATION.

President, James Wilson, Washington, D. C.; vice-president, Chas. W. Ward, Queens, N. Y.; secretary, W. M. Hays, Washington, D. C.; treasurer, N. H. Gentry, Sedalia, Mo.; chairman, animal section, A. P. Grout, Winchester, Ill.; secretary, animal section, C. B. Davenport, Cold Spring Harbor, N. Y.; chairman, plant section, H. J. Webber, Ithaca, N. Y.; secretary, plant section, N. E. Hansen, Brookings, S. Dak.

FARMERS' NATIONAL CONGRESS.

President, B. Cameron, Stagville, N. C.; first vice-president, Joshua Strange, Marion, Ind.; second vice-president, L. B. Strayer, Rock Island, Ill.; treasurer, W. L. Ames, Oregon, Wis.; secretary, George M. Whitaker, Washington, D. C.; first assistant secretary, John H. Kimble, Port Deposit, Md.; second assistant secretary, Ralph M. Searles, Edgar, Nebr., third assistant secretary, O. D. Hill, Kendalia, W. Va.; executive committee, president, secretary, and treasurer, E. W. Wickey, East Chicago, Ind; Levi Morrison, Greenville, Pa.; A. C. Fuller, Dows, Iowa.

PATRONS OF HUSBANDRY.

OFFICERS OF NATIONAL GRANGE.

Master, N. J. Bachelder, Concord, N. H.; overseer, T. C. Atkeson, Morgantown, W. Va.; lecturer, G. W. F. Gaunt, Mullica Hill, N. J.; treasurer, Mrs. E. S. McDowell, Rome, N. Y.; secretary, C. M. Freeman, Tippecanoe City, Ohio; executive committee, F. N. Godfrey, Olean, N. Y.; C. J. Bell, East Hardwick, Vt.; F. A. Derthick, Mantua, Ohio; N. J. Bachelder, ex officio, Concord, N. H.

REVIEW OF WEATHER CONDITIONS OF THE YEAR 1907.

By JAMES BERRY, *Chief of Climatological Division, Weather Bureau.*

The following weather summary of the year 1907 is prepared in conformity with the plan by which the National Weather Bulletin is issued, that is, by months during January, February, and March; by weeks ending with Monday from April to September, inclusive, and again by months during the remainder of the calendar year:

Probably the most remarkable meteorological feature of the year was the high temperature throughout the greater part of the country east of the Rocky Mountains during the second and third decades of March, when the previous maximum temperature records were greatly exceeded at a majority of Weather Bureau stations.[a] From the fore part of April, however, until the latter part of June the temperature over most of the country east of the Rocky Mountains was abnormally low; but the latter part of the season was more favorable, with the mean temperature materially above the normal at times.

Extensive areas in Texas and the upper Missouri Valley, much of the Lake region, New England, and the South Atlantic States, and scattered areas in the Middle Atlantic States and lower Mississippi Valley received less than the usual amount of rain, and western Texas, northern Georgia, and the greater part of the Florida Peninsula suffered seriously from drought. As a whole, however, the precipitation was ample and well distributed.

The year was remarkably free from storms of unusual severity.

The following is a condensed summary of the information collected and published during the year:

JANUARY.

January, 1907, was exceptionally cold over the western portions of the Dakotas, Montana, northern Idaho, and eastern Washington, and averaged colder than usual generally throughout the Pacific Coast States, over the western portion of the Southern Plateau region, northern portion of the Missouri and upper Mississippi valleys and Upper Lake region, and in northern New England; elsewhere the month averaged milder than usual, and was abnormally mild in the Southern States and over the southern portion of the central valleys and Middle Atlantic States. The deficiency in the mean temperature from the western portion of the Dakotas to northern Idaho ranged from 6° to 18° per day, and the excess in the Southern States, from 6° to 12° per day.

Over the southern Rocky Mountain region the weather was milder than usual throughout the month; and over the whole of the country east of the Rocky Mountains, with the exception of the upper Missouri Valley, the first and second decades were exceptionally mild. The mean temperature for the second decade ranged from 10° to more than 20° above the normal in the Southern States. The last decade was colder than usual in nearly all districts east of the Rocky Mountains, the deficiency in temperature ranging from 6° to 12° over the more northerly districts.

COLD WAVES.

There were several cold waves, most all of which were of small extent and short duration. The only one of importance made its appearance in the Canadian Northwest on the morning of the 24th. In the next twenty-four hours it advanced to the western shores of Lakes Michigan and Superior, a minimum temperature of 26° below zero being reported at Devils Lake. On the morning of the 26th it was central over the Ohio Valley, freezing temperatures being reported in the northern portions of Texas, Louisiana, Mississippi, and Alabama, and by the morning of the 27th it had reached the middle Atlantic coast with greatly diminished area and intensity.

HIGH RIVER STAGES.

The precipitation was below the average in the Gulf States and in the Atlantic coast districts, except over limited areas in the Middle Atlantic States and New

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[a] At Washington, D. C., on March 23 the temperature rose to 93°, which was not exceeded at any time during the succeeding summer and was equaled but once, namely, on July 8.

England, where there was a slight excess. It was also below the average over portions of the eastern Rocky Mountain slope, in the central Missouri Valley, the northern portion of the upper Mississippi Valley, parts of the upper Lake region, on the north Pacific coast, and over small areas in California and the Plateau regions. The deficiency in the Atlantic coast and Gulf States was very marked, ranging from 1 inch to 5 inches, the greatest shortage occurring over the interior portions of the central and east Gulf States. Generally throughout California and the Plateau regions and from Oklahoma and northern Texas northeastward over the central valleys and most of the Lake region the precipitation exceeded the average. From central Arkansas over the central Mississippi and Ohio valleys the monthly amounts ranged from 6 to more than 12 inches and caused flood stages in the Ohio River and its tributaries and in the Mississippi southward of Cairo, Ill.

DEEP SNOW IN NORTHERN DISTRICTS.

At the close of the month the northern portions of the country were covered with snow, the southern limit extending through the central valleys to the Atlantic coast in northern New Jersey. In the more northerly districts from Idaho eastward to the upper Lake region the depths ranged from 6 inches to more than 2 feet, and in the lower Lake region and northern New England from 3 inches to more than 1 foot.

There was much cloudiness in the central valleys, Lake region, and north Atlantic coast districts.

FEBRUARY.

The mean temperature during February, 1907, was above the normal on the east Gulf coast, in southern Wisconsin, northern Illinois, and in all districts westward of the Mississippi River; the month averaged exceptionally mild throughout the central Rocky Mountain and middle Plateau regions, where the average daily temperature excess generally ranged from 6° to more than 12°; the most marked departures occurred in the middle Plateau region, where the month was milder than any previous February for a number of years.

In Tennessee, southern Florida, the Ohio Valley, and most of the Lake region and throughout the Atlantic coast districts northward of Georgia the month averaged colder than usual, and was decidedly cold in New England, the Middle Atlantic States, upper Ohio Valley, and over the eastern part of the lower Lake region, where the temperature deficiency ranged from 6° to 8° per day.

The maximum temperatures of the first and second decades were unusually high over the western portions of the country. There were but two cold waves of importance during the month, the first occurring from the 2d to the 4th, and the second on the 26th and 27th.

The month was exceptionally dry over much the greater part of the country. Over a large part of the Lake region and central valleys the total precipitation did not exceed 1 inch—extensive areas receiving less than one-half inch—and while the total fall over much of the Middle Atlantic and Southern States ranged from 2 to more than 4 inches, there was a large deficiency as compared with the average in these districts. In the Rocky Mountain and Pacific coast regions there was also less than the average precipitation. A few small areas, mostly in the South Atlantic and east Gulf States, received more than the average amount, but there was no marked excess in any part of the country east of the Rocky Mountains. Portions of the middle Rocky Mountain and Plateau regions, extreme northern California, and portions of Oregon, Washington, and northwestern Montana also received more than the average, quite a marked excess occurring in northern Utah, southwestern Idaho, and on the extreme northern California coast.

MARCH.

Over much the greater part of the country March, 1907, averaged milder than usual. Throughout the central valleys and Southern States and over a large part of the Lake region the temperature excess ranged from 6° to 12° per day. While the temperature averaged above the normal almost continuously throughout the month over a large part of the country, the marked excess in the districts east of the Rocky Mountains was due principally to the phenomenally warm weather that prevailed during the last decade. Generally the month

averaged cooler than usual in the Pacific coast States, over a small area comprising northeastern Montana and northwestern North Dakota, and in Maine. As a whole, the deficiency in temperature in these districts was very slight, except in northern California, where it ranged from 3° to 6° per day.

UNUSUAL WARMTH.

During the remarkably warm weather of the second and third decades of the month over a large part of the country east of the Rocky Mountains, previous maximum temperature records for the second decade were exceeded by from 1° to 12° at a majority of Weather Bureau stations over the middle Rocky Mountain slope and Southern States, and at stations in southern California, and the maximum temperature records of former years for the third decade were exceeded by from 1° to 6° in the central valleys, and 4° to 9° in the Atlantic coast districts.

In the Plateau regions, California, and southern Oregon the precipitation was greater than the average, marked excess—ranging from 2 to more than 5 inches—occurring in the middle Plateau and middle Pacific coast regions. In the Ohio Valley, portions of the central Mississippi and lower Missouri valleys, and over the greater part of the Lake region, the precipitation was also above the average, the excess ranging from 1 inch to more than 2 inches over portions of these districts. On the north Pacific coast, over the eastern Rocky Mountain slope, and generally throughout the Atlantic coast and Gulf districts, the precipitation was lighter than usual, the deficiency in the central and east Gulf States ranging from 2 to more than 5 inches.

There was practically no snow on the ground east of the Rocky Mountains at the end of the month, except over the western portion of the upper Michigan Peninsula, where a depth of 4 inches still remained.

At the close of the month the season was reported to be from two to four weeks in advance of the average in the central valleys and Southern States.

As a whole the weather conditions were generally favorable for farming operations in the districts east of the Rocky Mountains.

The Crop Season, April–September, Summary by Weeks.

By weeks, ending with Monday, from April 8 to September 30, the weather conditions may be summarized as follows:

April 8.—East of the Mississippi River and generally on the Pacific coast the weather was colder than usual, but in the region from the Mississippi westward to the Plateau regions it was generally mild. The deficiency on the Pacific coast and from the east Gulf coast northward to the Lake region was slight, generally ranging from 1° to 3°, but in the Atlantic coast districts and upper Ohio Valley it ranged from 3° to 8°. From the west Gulf coast northward to the Dakotas and over the Rocky Mountain and Plateau regions the mean temperature was above the normal. The excess ranged from 3° to 6° per day over the greater part of these districts, being most marked over the middle Rocky Mountain region and in northwestern Texas. Heavy frosts occurred during the fore part of the week generally throughout the central valleys and Atlantic coast and east Gulf districts.

The weekly precipitation was below the average in California, over the northeastern Rocky Mountain slope and most of the Missouri Valley, in the central and west Gulf districts, southern Florida, and portions of the east Gulf States, and generally in the lower Lake region, the northern portion of the Middle Atlantic States, and New England, the most marked deficiency existing along the immediate central and west Gulf coasts, where little or no rain fell. There was more than the average precipitation on the north Pacific coast, over the southern Rocky Mountain and Plateau regions, and over an area extending from Oklahoma eastward over Arkansas, the Ohio Valley, Tennessee, Virginia, and North Carolina; there was also more than the average in portions of the upper Mississippi Valley and upper Lake region. The heaviest precipitation occurred on the north Pacific coast, where it generally ranged from 2 to 4 inches. Northeastern Texas, portions of Arkansas, Tennessee, the northern portions of Mississippi and Alabama, southern Georgia, and the eastern portions of the Carolinas received amounts ranging from 1 inch to more than 2 inches.

The sunshine was deficient on the north Pacific coast, in the Ohio Valley, and generally in the Middle and South Atlantic States.

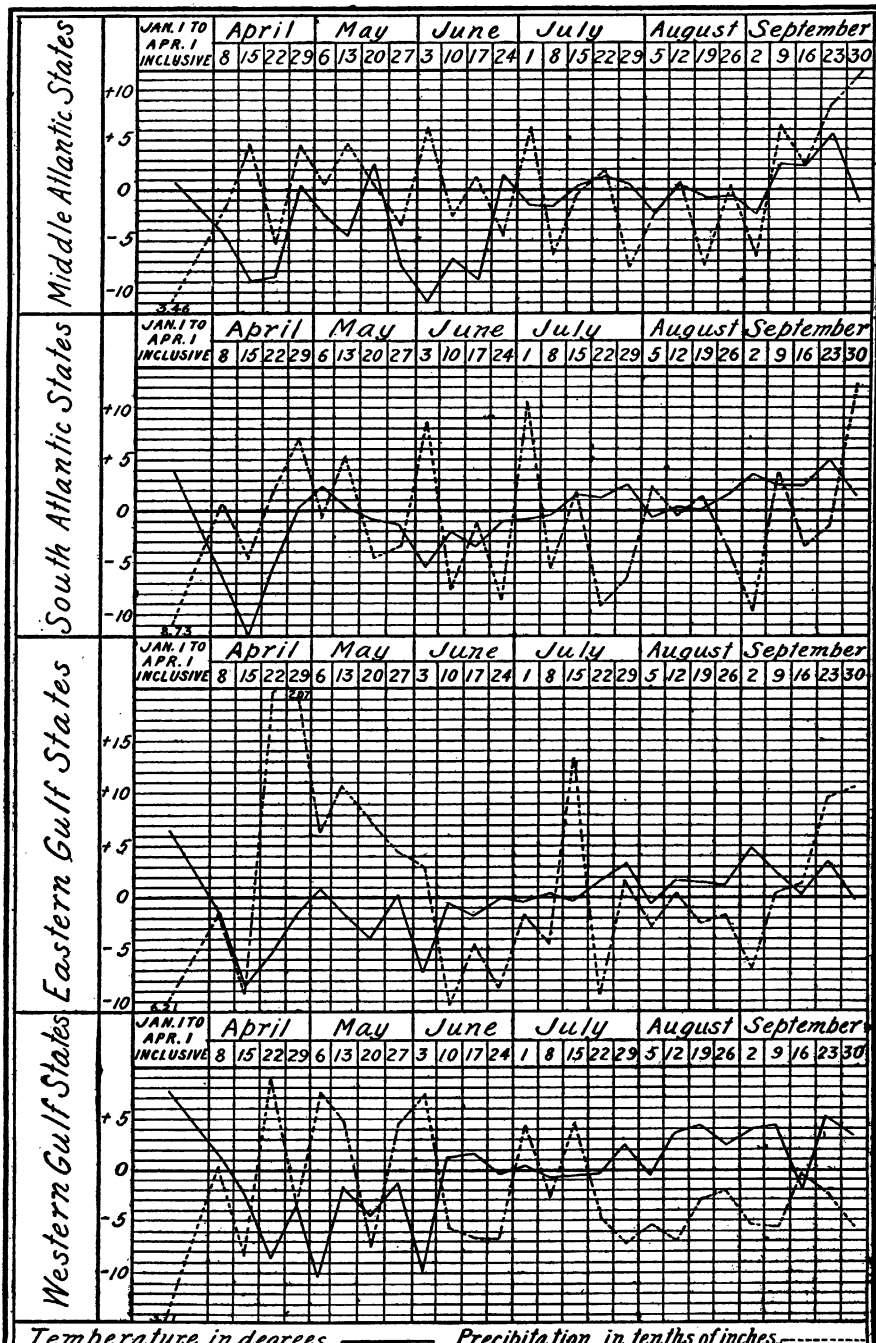


FIG. 53.—Departures from normal temperature (degrees Fahrenheit) and precipitation (inches) for the season of 1907, for the Middle Atlantic, South Atlantic, and Gulf States.

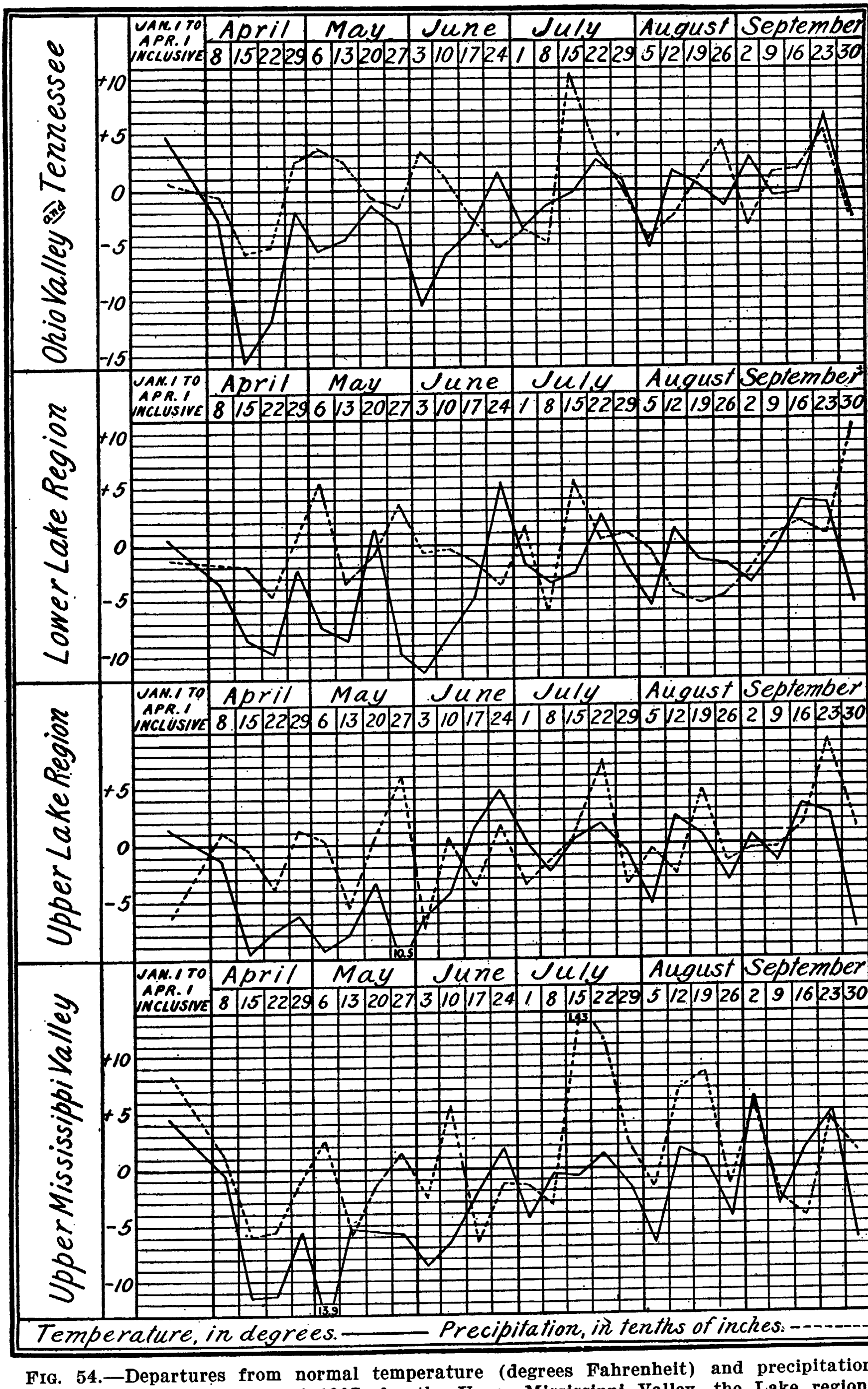


FIG. 54.—Departures from normal temperature (degrees Fahrenheit) and precipitation (inches) for the season of 1907, for the Upper Mississippi Valley, the Lake region, and the Ohio Valley and Tennessee.

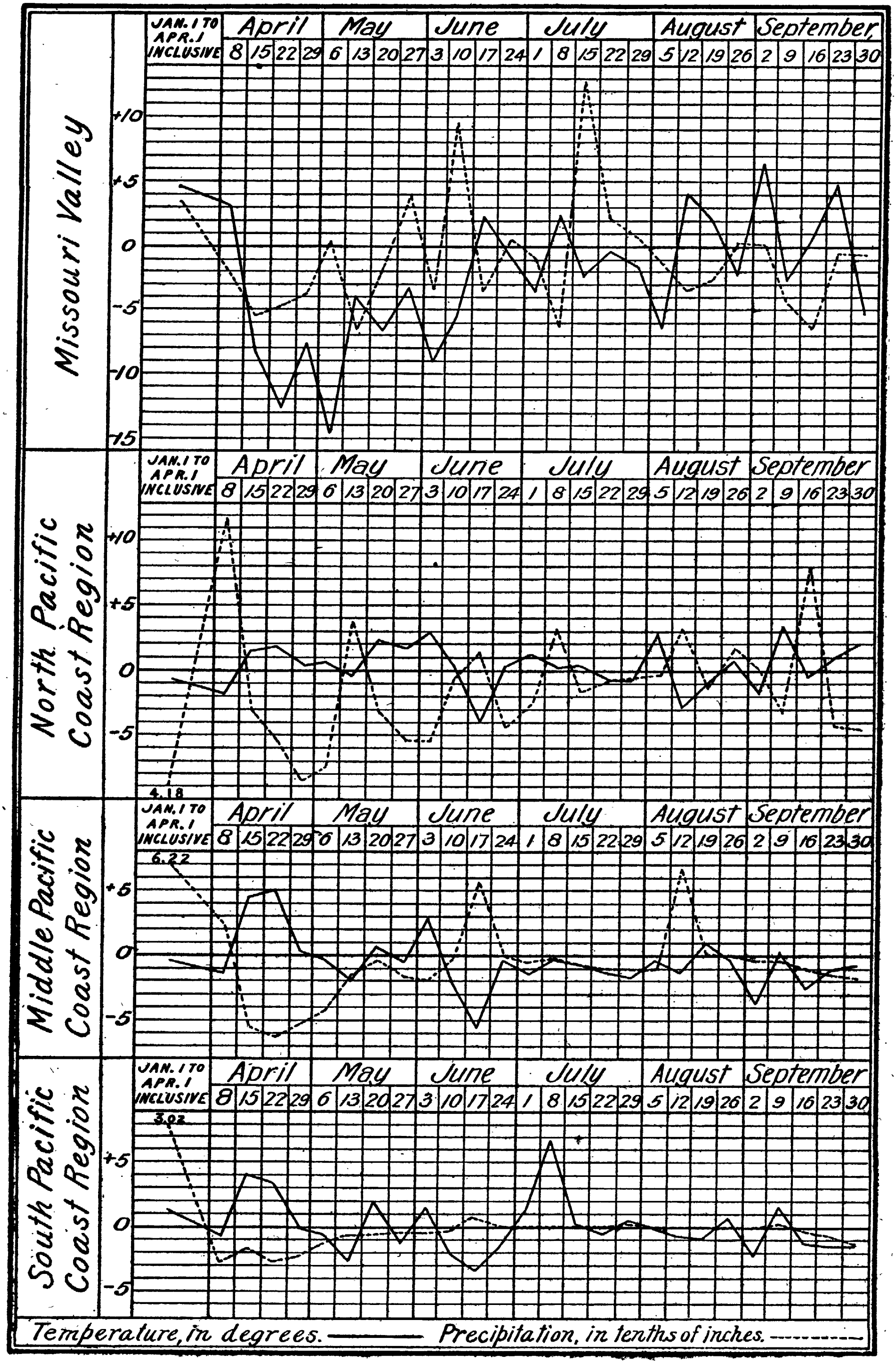


FIG. 55.—Departures from normal temperature (degrees Fahrenheit) and precipitation (inches) for the season of 1907, for the Missouri Valley and the Pacific Coast.

LOW TEMPERATURES IN EASTERN DISTRICTS.

April 15.—In nearly all districts east of the Rocky Mountains the weather was decidedly cold and for the most part dry, although New England and portions of the Middle Atlantic States and upper Lake region received more than the usual amount of precipitation. The abnormally low temperatures were generally unfavorable in all districts east of the Rocky Mountains, freezing temperatures extending to the southward of Kansas and Missouri and to the central portions of Alabama and Georgia. Heavy frosts occurred as far south as the northern portion of the west Gulf States, the central portion of the east Gulf States, and to the south Atlantic coast. Generally favorable temperatures prevailed in the Rocky Mountain and Pacific coast regions, where the weather was milder than usual, although freezing temperatures occurred in the northern Rocky Mountain region and frosts in Washington and Oregon.

Heavy snow fell in the upper Lake region and New England and over the interior portions of the Middle Atlantic States and light snow in the Ohio and upper Mississippi valleys.

Drought was becoming severe in the central and west Gulf districts.

Mountain streams in the central and northern Rocky Mountain regions were unusually high as a result of melting snow.

HEAVY RAINS IN THE GULF STATES; DRY WEATHER ELSEWHERE.

April 22.—This was the third consecutive week of abnormally cold weather in the districts east of the Mississippi River. The mean temperature was considerably below the normal in the Plateau regions; in all districts to the eastward, with the exception of Florida, the temperature was decidedly below the normal, the most marked deficiencies occurring in the central valleys.

The general weather conditions of the week were unfavorable in nearly all districts east of the Rocky Mountains, but on the Pacific coast and in the southern Plateau region they were favorable.

Freezing weather prevailed as far south as northwestern Texas, the central Mississippi and upper Ohio valleys, western North Carolina, and to the New Jersey coast, with heavy frosts as far south as Arkansas and Tennessee.

Except in the Gulf States and over the southeastern Rocky Mountain slope, where the precipitation was much above the normal, the week was generally dry, large areas in the central valleys and Lake region receiving no rain or only inappreciable showers. There was also a practical absence of rain on the northern New England coast, in southern Florida, southern Oregon, and over the western portions of the central and southern Plateau regions and in California.

The drought in the central Gulf districts was relieved, but rain was needed over a large part of the upper Mississippi and lower Missouri valleys.

Snow and sleet occurred over a large part of the central valleys on the 16th and 18th, and scattered hailstorms in the South Atlantic States on the 18th.

There was much cloudiness in the South Atlantic and Gulf States, but ample sunshine in the central valleys.

LOCAL STORMS IN SOUTHERN STATES.

April 29.—The weather was abnormally cold and unfavorable in all districts between the Rocky Mountains and the Mississippi River, and also in the upper Lake region. Over most of the area east of the Mississippi the fore part of the week was also cold and unfavorable, but the latter part was mild and favorable. The Pacific coast States experienced a week of mild dry weather, which was generally beneficial.

The line of freezing temperature was much farther north than in the preceding week in the Rocky Mountain and Atlantic coast districts, but only slightly farther north in the central valleys. Light to killing frosts occurred in northern and western Texas and light frosts in the northern portions of the central Gulf States.

Very heavy rains occurred on the central Gulf coast. A large part of the upper Mississippi and lower Missouri valleys needing moisture received plentiful rainfall.

Severe local storms occurred in portions of the Middle and South Atlantic and west Gulf States.

Snow fell in the Dakotas, Minnesota, Wisconsin, and Michigan in depths ranging from 1 inch to 12 inches, and there was considerable snow on the ground in the upper Michigan Peninsula at the close of the week.

HEAVY SNOWS IN THE CENTRAL VALLEYS AND LAKE REGION.

May 6.—In the South Atlantic and east Gulf States and in most of the Pacific coast region the temperature was normal, or above, and generally favorable. In the Rocky Mountain region, west Gulf States, central valleys, and Lake region the weather was abnormally cold and decidedly unfavorable. Temperatures much below freezing occurred throughout the central and northern Rocky Mountain region, in the Missouri and upper Mississippi valleys, and in the Lake region and northern New England, a minimum of 6° occurring at Devils Lake, N. Dak., on the 2d. Heavy frosts were general in the northern districts and light to heavy frosts occurred as far south as northwestern Texas, Oklahoma, northern Arkansas, Tennessee, and the Middle Atlantic States.

There was ample moisture in all districts, except in southern Florida and portions of northern Iowa and South Dakota, excessive and damaging rains having fallen in the lower Mississippi Valley and central Gulf districts.

Heavy snow occurred in portions of the central valleys and Lake region on the 3d and 4th.

There was much cloudiness, especially in the Atlantic coast and Gulf States.

EXCESSIVE RAINS AND DAMAGING HAILSTORMS IN SOUTHERN STATES.

May 13.—While the temperature conditions in the Southern States were more seasonable than in preceding weeks, excessive rains proved generally unfavorable. The northern and central portions of the country continued to experience abnormally low temperatures, but the deficiency was less marked than for several weeks.

Light to heavy frosts were general in the upper Missouri, upper Mississippi, and Ohio valleys, Lake region, and Middle Atlantic States.

The absence of rain in the upper Missouri Valley was beginning to be felt, while the droughty conditions in Oregon were wholly or partially relieved.

Damaging hailstorms occurred in portions of the west Gulf and South Atlantic States during the fore part of the week.

There was much cloudiness in the Atlantic coast and Gulf districts until the latter part of the week, but in the central valleys and Western States the sunshine was generally ample.

While generally cloudy weather prevailed on the Pacific coast during the latter part of the week, the conditions in that region, as a whole, were favorable.

MILDER TEMPERATURES BENEFICIAL.

May 20.—Although there was a well-marked deficiency in the mean temperature in the central valleys and Southern States, as compared with the normal, the conditions were more favorable than in any preceding week since April 1. In New England, the Middle Atlantic States, lower Lake region, and on the north Pacific coast the week averaged warmer than usual and was generally favorable.

Light to heavy frosts occurred in the Lake region and central valleys, and light frosts as far south as Arkansas, Tennessee, and the interior of the Middle Atlantic States. Minimum temperatures much below freezing occurred throughout the central and northern Rocky Mountain districts, the upper Missouri Valley, and over the northern portions of the upper Mississippi Valley and upper Lake region.

Portions of the central and lower Mississippi Valley and east Gulf States suffered from excessive rain, while droughty conditions existed in western Texas and portions of the central Missouri Valley.

A light fall of snow occurred in the lower Missouri Valley on the 14th.

There was much cloudiness over the northeastern Rocky Mountain slope and in the central Missouri Valley. Thoroughout the Atlantic coast and Gulf districts the sunshine was generally above the average.

INJURIOUS FROSTS AND EXCESSIVE RAINS.

May 27.—In the northern districts eastward of the Rocky Mountains, and especially in the Lake region, upper Ohio Valley, northern part of the Middle

Atlantic States, and New England, the weather during the week was unseasonably cold and unfavorable. Freezing temperatures occurred in the middle and northern Rocky Mountain regions, and from the upper Missouri Valley eastward to northern New England and in the higher portions of the Middle Atlantic States, and injurious frosts in the central valleys and as far south as western North Carolina. In the Southern States generally favorable temperatures prevailed, but the central Gulf districts suffered from excessive rains. Unusually heavy rains also occurred in the upper Missouri Valley and northern Rocky Mountain region. There was a heavy fall of snow in Wyoming and northern Utah on the 24th.

In the lower Missouri, central Mississippi, and lower Ohio valleys and in the South Atlantic and east Gulf States there was abundant sunshine, but generally cloudy weather prevailed in the lower Lake region and in the upper Missouri Valley.

Generally favorable weather conditions prevailed on the Pacific coast, with somewhat less than the average sunshine in Oregon and California.

ABNORMAL COLD CONTINUES IN MOST DISTRICTS.

June 3.—The Florida Peninsula, the Pacific coast States, and the western portions of the middle and northern Plateau districts experienced favorable temperatures, the averages being generally considerably above the normal; elsewhere, the abnormally cold weather that had been so pronounced a feature over most of the country during the preceding two months continued throughout the week, although the deficiency in temperature was less marked in Minnesota and North Dakota, where the week was the most favorable of the season thus far. The abnormally cold weather was decidedly unfavorable throughout the central valleys and the Atlantic coast and Gulf districts. Light to heavy frosts were general in the Lake region, Ohio Valley, New England, and the Middle Atlantic States, light frosts occurring as far south as western North Carolina, northern Alabama, and Arkansas.

Portions of the lower Ohio Valley, southern Louisiana, and a large part of Texas suffered from very heavy rains, which caused destructive freshets. Light snow and sleet occurred in the lower Lake region on the 27th.

Unusual cloudiness prevailed in nearly all districts east of the Rocky Mountains; there was, however, somewhat less cloudiness than in the previous week in the northern districts west of the upper Lake region.

HEAVY RAINS PRODUCE HIGH RIVER STAGES.

June 10.—On the Pacific coast and in the central and west Gulf States the temperature during the week was favorable, and beneficial temperature also prevailed during the latter part in Tennessee and the east Gulf States; elsewhere, the weather was abnormally cold, especially over the northern portion of the central valleys and in the Lake region and Atlantic coast districts northward of North Carolina.

Light frosts occurred in the western portion of the upper Lake region and in the lower Lake region.

Portions of the lower Missouri, central Mississippi, and Ohio valleys experienced very heavy rains, which caused overflows that resulted in considerable damage. In the Southern States the rainfall was very light, none having fallen over a large part of that section.

Cloudy weather was prevalent generally throughout the central and northern districts east of the Rocky Mountains, but in the Southern States there was abundant sunshine.

June 17.—The temperature was highly favorable in the States of the Missouri Valley and was generally favorable in the Southern States, but in the Atlantic coast districts northward of Georgia and in the lower Lake region and upper Ohio Valley the temperature was much too low for favorable results. There was, however, a decided rise in the temperature in these districts at the close of the week. The Plateau regions and most of the Pacific coast States experienced a week of very low temperature.

Frosts occurred in exposed localities in the lower Lake region and northern part of the Middle Atlantic States on the 12th and 13th; frosts and snow occurred in the middle and northern Rocky Mountain regions.

Portions of the Ohio Valley and South Atlantic and east Gulf States suffered from local storms and heavy rainfall. The principal agricultural districts had ample moisture.

Generally throughout the central valleys and Southern States and in the lower Lake region and New England there was abundant sunshine, but in the middle and South Atlantic States and in the middle and northern Rocky Mountain districts and on the Pacific coast there was less than the average.

SUMMARY OF AN ABNORMALLY COLD PERIOD.

A remarkably warm spell during the last decade of March was followed by an almost unbroken period of abnormally cold weather over the greater part of the country. For this reason the temperature departures from April 1 to June 17 are of especial interest. During this period of 78 days the mean temperature was slightly above the normal in southern Florida, along the immediate coast of central and southern California, in northern California, and over the western portions of Oregon and Washington; elsewhere, it was below the normal, the deficiency ranging from 2° to 4° per day in the southern portions of the country and in the Rocky Mountain region, from 4° to 6° over the southern portions of the central valleys and in the Middle Atlantic States and lower Lake region, and from 6° to 8° in the Ohio, upper Mississippi, upper Missouri, and Red River of the North valleys, the most marked deficiency being shown in Minnesota and North Dakota.

WEATHER CONDITIONS GENERALLY FAVORABLE.

June 24.—Except in the Plateau regions during the fore part of the week, the whole country experienced very favorable temperatures. Frosts occurred in the Plateau and middle Rocky Mountain regions and snow in the mountains of California and Montana.

Rain was needed throughout Tennessee, southern Alabama, and the coast counties of Texas; elsewhere in the central and eastern portions of the country there was generally sufficient moisture. There was less than the average precipitation on the north Pacific coast. The week was comparatively free from severe local storms.

There was a high percentage of sunshine in the districts east of the Mississippi River and also in the west Gulf States. While the latter part of the week was more or less cloudy in the States of the Missouri Valley, there was generally ample sunshine.

DRY WEATHER IN TEXAS; SEVERE LOCAL STORMS.

July 1.—Although it was considerably cooler than usual in the middle Rocky Mountain region and central valleys, the temperature in the last-named districts was generally favorable; in the Rocky Mountain region, cool nights during the fore part of the week were detrimental, light frosts occurring in portions of Idaho, New Mexico, and Arizona. The Lake region and Atlantic coast and Gulf districts experienced a week of nearly normal and generally favorable temperature.

A large part of Texas and portions of Louisiana and South Dakota needed rain, but elsewhere in the principal agricultural districts there was sufficient moisture.

Several local storms occurred in portions of Oklahoma, Kansas, Nebraska, and Missouri and also in the South Atlantic States and New England; elsewhere the week was comparatively free from storms of this character.

In the Carolinas, Georgia, and Florida there was less than the usual sunshine, and cloudy to partly cloudy weather prevailed during a part of the week in the Lake region and upper Mississippi Valley; elsewhere east of the Rocky Mountains the duration of sunshine was normal or above.

TEMPERATURE AND RAINFALL GENERALLY FAVORABLE.

July 8.—The fore part of the week was unusually cool in the Lake region, upper Ohio Valley, and Middle Atlantic States, light frosts occurring in Michigan and northern Ohio on the morning of the 3d. Elsewhere the temperature was generally favorable, although southern California, especially in the vicinity of Los Angeles, experienced a week of abnormal heat.

Heavy rains fell in Florida and adjacent portions of Georgia and Alabama, also in central-southern Texas and over limited areas in central Gulf and Middle Atlantic States and over considerable areas in the central Missouri, upper Mississippi, and upper Ohio valleys, eastern South Dakota, southern

Wisconsin, and northern New England. As a whole, however, the week was dry, much the greater part of the Lake region, central valleys, and Atlantic coast districts receiving less than the average rainfall, and a large part of the central valleys only very light showers or no appreciable amount. Portions of Oklahoma, Missouri, southern Illinois, Texas, and Louisiana needed rain more or less urgently; elsewhere in the principal agricultural districts there was generally ample moisture for current needs.

Cloudiness prevailed during the fore part of the week in the South Atlantic and east Gulf States, and there was somewhat less than the usual amount of sunshine in the upper Lake region; elsewhere east of the Rocky Mountains the sunshine was much above the average, and was almost uninterrupted in the States of the lower Missouri Valley.

Destructive local storms occurred in Minnesota and Wisconsin on the 2d and 3d, in southwestern Virginia on the 2d, in southwestern Ohio on the 6th, and in Maine and New Hampshire on the 7th.

MUCH NEEDED RAINS IN SOUTHERN DISTRICTS; LOCAL STORMS IN NORTHERN STATES.

July 15.—The general weather conditions of the week were favorable over most of the country.

The drought prevailing at the close of the previous week in portions of Oklahoma, Missouri, Texas, and Louisiana was wholly, or in part, relieved, and portions of the lower Missouri and upper Mississippi valleys experienced excessively heavy rains that caused damage in some places.

Severe local storms were more numerous than in any previous week of the season in the northern districts from the Missouri Valley eastward, but the Southern States were comparatively free from such storms.

There was much cloudiness in Texas, the Missouri Valley, and middle Rocky Mountain region; elsewhere there was the normal, or more than the normal, amount of sunshine.

RAINFALL UNEVENLY DISTRIBUTED.

July 22.—Cool weather generally prevailed in the Rocky Mountain and Plateau regions and in the upper Missouri Valley, light frosts occurring during the fore part of the week in portions of the middle and southern Plateau regions. Over the central and eastern portions of the country it was warmer than usual.

Portions of the Missouri and upper Mississippi valleys suffered considerably from heavy rains, while Oklahoma and portions of Texas, Missouri, Tennessee, North Carolina, and Massachusetts needed rain.

As in the previous week the severe local storms were confined to the central and northern districts, the Southern States being practically free from storms of this character.

In the Dakotas, Minnesota, and Iowa there was generally less than the usual sunshine, and there was considerable cloudiness in the South Atlantic States and on the north Pacific coast; elsewhere there was abundant sunshine, the percentage of the possible being unusually high in the central and west Gulf States.

MOISTURE NEEDED IN TEXAS AND OKLAHOMA.

July 29.—Very hot weather prevailed over the central and eastern portions of the Southern States, and the mean temperature was normal or slightly above on the middle Atlantic coast, in the west Gulf States, on the south Pacific coast, and over most of Washington and Oregon. The weather was unseasonably cool in the southern Plateau region and upper Missouri Valley, and somewhat cooler than usual in the Lake region, upper Mississippi and Ohio valleys, and northern New England.

Rain was badly needed in Texas and Oklahoma, and the need of moisture was beginning to be felt in portions of Mississippi, Tennessee, southern Indiana, the Middle Atlantic States, and southern New England; elsewhere east of the Rocky Mountains there was generally ample moisture for current needs.

The week was comparatively free from destructive local storms.

There was considerable cloudiness in the South Atlantic States and lower Missouri Valley during the latter part of the week, and partly cloudy weather prevailed over the western portion of the upper Lake region during the fore part of the week; elsewhere east of the Rocky Mountains the sunshine was normal or above, being generally excessive in the west Gulf districts.

COOL WEATHER IN CENTRAL VALLEYS; LOCAL DROUGHT PARTIALLY RELIEVED.

August 5.—The weather was abnormally cool in the central valleys and Lake region during the week, the lowest temperatures occurring during the last four days, when they were not far from freezing in North Dakota and at exposed places in the upper Lake region. Light but harmless frosts occurred in the Dakotas on the 2d. In the Middle Atlantic and Southern States and generally throughout the Rocky Mountain and Pacific coast districts the temperature was favorable. The first three days of the week were very warm on the north Pacific coast.

Rains relieved drought in extreme northern Texas and portions of Oklahoma, but drought continued over the greater part of Texas and in portions of the central Gulf and Middle Atlantic States, Tennessee, and Missouri.

There were very few local storms of severity, and those occurring were largely confined to the South Atlantic States, southern portion of the upper Lake region, the central Missouri Valley, and middle Rocky Mountain region.

The sunshine was below the normal in the South Atlantic and east Gulf States and over the southern Plateau region; elsewhere it was normal, or above, the percentage being unusually high in the northern districts east of the Rocky Mountains.

HOT AND CONTINUED DRY IN WESTERN COTTON STATES.

August 12.—Temperature slightly in excess of the normal prevailed in the Lake region, central valleys, and New England. The northern portion of the central Gulf States and an area extending from central Texas northward to eastern Kansas and southwestern Missouri experienced abnormal heat. The weather was decidedly cool in the central and northern Plateau regions, the eastern portions of central and northern California, and the greater part of Oregon and Washington. The temperature was but little above freezing in northern Nevada on the 10th, and some light frosts occurred in Idaho and Wyoming.

The rainfall was ample in the lower Missouri, upper Mississippi, and lower Ohio valleys and over the greater part of the South Atlantic and east Gulf States; but it was insufficient over most of New England and the lower Lake region and in portions of North Dakota, Indiana, Tennessee, and the central Gulf States. Drought, more or less serious, prevailed in Texas, Oklahoma, and nearly all of Arkansas, where practically no rain fell. There was an abnormally heavy rainfall on the northern California coast, nearly 3 inches of rain falling at Eureka.

There were very few local storms, and those reported were mostly in the Middle Atlantic States and occurred on the 9th.

There was less than the usual sunshine in portions of the Middle and South Atlantic and east Gulf States, in New Mexico, and on the north Pacific coast; elsewhere it was normal, or above.

EXCESSIVE HEAT IN TEXAS AND OKLAHOMA; NEED OF RAIN IN MANY SECTIONS.

August 19.—The weather was excessively hot in northern Texas and Oklahoma and the temperature was considerably above the normal in Arkansas, southern Missouri, and Kansas; elsewhere east of the Rocky Mountains the temperature conditions were generally favorable. Unseasonably cool weather prevailed in the northern Rocky Mountain region and over the eastern portions of the north Pacific coast States, where light frosts were frequent. Light frosts also occurred in the northern portion of the upper Lake region and in northern New England.

Drought of more or less severity continued in Texas, Oklahoma, and southern Arkansas, and was becoming severe in southern New England and the northern portion of the Middle Atlantic States. Western North Carolina, central Mississippi, and portions of Ohio, Kentucky, and South Dakota also needed rain. Elsewhere east of the Rocky Mountains there was ample moisture, heavy rains having fallen in portions of the Missouri and upper Mississippi valleys and South Atlantic States.

The local storms reported were largely confined to the upper Mississippi Valley, where they caused considerable damage.

The sunshine was above the average, except in the South Atlantic States.

DROUGHT AREA SOMEWHAT DECREASED.

August 26.—The week was abnormally cool in the upper Lake region, central valleys, and middle Plateau region, and light to heavy frosts occurred in nearly all of the extreme northern States from Montana to New York. The temperature conditions on the Atlantic and Pacific coasts differed but slightly from the normal, while in the Gulf States the weather was considerably warmer than usual, especially in the western districts.

Drought continued in New York, northern Ohio, and western Alabama, and with increasing severity over the greater part of Texas; it was partially relieved in New England, Oklahoma, and South Dakota and wholly relieved in northern New Jersey, Pennsylvania, Mississippi, Arkansas, and Missouri.

There was more than the usual amount of cloudiness in the middle and southern Rocky Mountain regions, Kentucky, Tennessee, and the South Atlantic States; elsewhere the sunshine was above the average.

The week was almost entirely free from local storms of severity.

DROUGHT AUGMENTED IN ATLANTIC COAST AND GULF STATES.

September 2.—The weather was abnormally cool in the Plateau regions, over the eastern portions of the Pacific coast States, and in portions of New England, the lower Lake region, and Middle Atlantic States. Light frosts occurred on the 28th in the upper Michigan Peninsula and the interior of northern New England, and on the 29th and 30th over the eastern portions of Washington and Oregon. In the central valleys and Southern States the weather was warmer than usual, the central Mississippi and lower Missouri valleys experiencing abnormal heat, which, however, was generally favorable.

The very light rainfall or the absence of precipitation over nearly all of the Atlantic coast and Gulf States largely increased the drought area in these districts, and augmented its severity in New England and the Southwest, Texas and Oklahoma suffering most.

Drought continued in eastern South Dakota and was being felt in northeastern Ohio and southwestern Kansas, while heavy rains caused damage in central Iowa.

There was more than the usual amount of cloudiness on the Pacific coast, over the eastern Rocky Mountain slope, and in the upper Missouri Valley; elsewhere the sunshine was above the average, the percentage being high in the Southern States.

The week was almost wholly free from severe local storms.

HOT WEATHER IN TEXAS; RAINS BENEFICIAL IN NEW ENGLAND AND OKLAHOMA.

September 9.—The week was marked by unusually hot weather in the Southern States, especially in central Texas, and also in the Atlantic coast States, California, and on the north Pacific coast, but was cooler than usual in the lower Missouri, upper Mississippi, and lower Ohio valleys and the greater portion of the Lake region. Temperature conditions were generally favorable, however, in practically all districts, excepting portions of Louisiana, Arkansas, and Oklahoma and the greater part of Texas. Light frosts were reported at the close of the week from the upper Michigan Peninsula, the Dakotas, and some Rocky Mountain stations.

Copious rains completely relieved the drought which had prevailed in New England, and the drought was broken in Oklahoma and generally relieved in North Carolina and northeastern Ohio, but continued in portions of the two last-named States, and many western counties in Alabama, in Louisiana, and the greater part of Texas, the conditions in the last-mentioned State being aggravated by hot, drying winds. Some scattered counties in South Dakota also needed rain.

While much cloudiness prevailed in New England, New York, the upper Lake region, Kentucky, portions of Kansas, and the northern Rocky Mountain region, and during the mornings on the Pacific coast, the sunshine in other sections was generally the average amount or above the normal, being excessive in Louisiana and Texas.

With the exception of damaging wind and hail storms in southern Indiana, there were no severe local storms reported during the week.

COOL WEATHER AND FROST IN MANY DISTRICTS.

September 16.—The weather was decidedly cool in Montana and the western portions of the Dakotas, and the fore part of the week was cooler than usual in the central valleys and upper Lake region. In the last-named district, however, and in the lower Lake region and Atlantic coast districts the mean temperature was considerably above the normal. The weather was cooler than usual in the central Gulf districts. Light or heavy frosts occurred in North Dakota on the 9th and 10th, in South Dakota and Nebraska on the 10th, in Colorado and Arizona on the 10th and 11th, in West Virginia on the 12th, in Montana, Idaho, and Nevada on the 13th, and in Utah on the 14th. While temperatures sufficiently low for frost occurred in the upper Lake region, cloudiness appeared to have prevented its formation.

Drought continued in western Texas and in portions of Alabama and the Carolinas, and rain would have proved beneficial in Oklahoma, Nebraska, eastern South Dakota, and northeastern Ohio; elsewhere east of the Rocky Mountains the precipitation was generally sufficient.

The percentage of sunshine was high throughout the central valleys and the Middle Atlantic and west Gulf States, but was below the normal in the east Gulf States and in the northern districts westward of the upper Lake region.

No unusually severe local storms were reported during the week.

RAINS BRING RELIEF TO OKLAHOMA AND PARTS OF TEXAS.

September 23.—The weather during the greater part of the week was unusually warm over most of the country east of the Rocky Mountains, particularly in the central valleys and Middle Atlantic States, but the week ended cool over the greater part of the region named, with light to heavy frosts in the upper Mississippi and upper Missouri valleys, upper Lake region, and northern New England. The weather was much cooler than usual in the middle and northern Plateau districts and northern Rocky Mountain region, where light to heavy frosts were frequent, and freezing temperatures occurred.

A large part of Oklahoma and northeastern Texas that was suffering from drought at the close of the preceding week received abundant rainfall, but drought continued in southern and western Texas and extreme northwestern Alabama, and a general rain was needed over the greater part of Missouri; elsewhere there was generally ample moisture, portions of the upper Mississippi Valley and Lake region and an area extending from the central and east Gulf coasts to southern New England having received excessive rains.

There was less than the usual sunshine in the central and east Gulf districts, from the upper Missouri Valley eastward to the lower Lake region, and over the northern portion of the Middle Atlantic States; the sunshine was in excess of the average in Virginia, the Carolinas, Tennessee, and the States of the Ohio, central Mississippi, and lower Missouri valleys.

HEAVY RAINS IN ATLANTIC COAST DISTRICTS; CONTINUED DRY IN CENTRAL AND WEST GULF STATES.

September 30.—Abnormally cool weather prevailed over the northern half of the country east of the Rocky Mountains, the deficiency in temperature being greatest in the Lake region, central valleys, and northern New England. Light to heavy frosts occurred on several dates, being most general on the 25th and 26th. On the latter date light frosts occurred as far south as eastern Tennessee and western North Carolina. The mean temperature was slightly above the normal in the South Atlantic and central and east Gulf States and decidedly above in Texas and on the north Pacific coast.

Heavy rains occurred in the Atlantic coast districts, except in portions of Virginia and Florida, the amounts ranging from 2 to more than 6 inches from northern Virginia to New England and on the east Gulf coast. Heavy rains also occurred over the central Missouri and upper Mississippi valleys and the southern portion of the Lake region. In the Ohio and central Mississippi valleys, throughout the central and west Gulf States, and to the westward of the upper Lake region there was no precipitation, or only light showers.

There was much cloudy weather in New England and in portions of the Lake region and South Atlantic States, and there was less than the average sunshine in the southern Plateau region and on the Pacific coast. In the central Mississippi and Ohio valleys and in the Middle Atlantic and central and west Gulf States the sunshine was above the normal.

Review of the Season.

For the period from March 1 to September 30 the mean temperature was above the normal over the southern half of the country east of the Rocky Mountains and below the normal in the Plateau regions and the northern districts to the eastward. In the Southern States the excess ranged from less than 1° over the interior districts to 2° on the central Gulf coast and in western Texas. In the northern portions of the country the deficiency for the most part exceeded 1° and ranged from 2° to 4° in the region extending from Montana eastward to the Great Lakes and northern New England.

The precipitation during the same period was below the normal on the north Pacific coast, in the valleys of the upper Missouri and the Red River of the North, the northern portion of the upper Lake region, most of Florida and western Texas, parts of Kansas, Missouri, Arkansas, northern Mississippi, southeastern Alabama, and northern Georgia, and over limited areas in the Middle Atlantic States and southern New England. It was above the normal in northern California, Idaho, western Montana, eastern Washington, the greater part of Arizona, New Mexico, and Colorado, in western Oklahoma and the central Gulf States, and over most of the central Missouri, upper Mississippi, and Ohio valleys, Lake region, Middle Atlantic States, and northern New England.

October.

As a whole, the weather conditions during October were favorable, although decidedly cool in the Lake region, upper Ohio Valley, Middle Atlantic States, and New England. Killing frosts occurred generally throughout the Southern States near the middle of the second decade and during the latter part of the third decade.

There was much less than the normal rainfall in the Middle and South Atlantic and east Gulf States and from the upper Lake region westward to the north Pacific coast. The rainfall exceeded the average from Kansas, Oklahoma, and Texas westward to the south Pacific coast and in the lower Ohio Valley, lower Lake region, and portions of New England and the Middle Atlantic States.

There was more than the usual sunshine over much the greater part of the country. On the north Pacific coast, in Arizona, and in portions of the central Gulf States and Lake region, however, there was much cloudiness.

November.

The first and last decades of November were mild and dry in the Lake region, central valleys, and to the westward. The middle decade was abnormally cool over most of the country east of the Rocky Mountains, freezing temperatures occurring nearly to the Gulf coast from the 12th to the 16th.

There was more than the usual rainfall in most of the Atlantic coast and Gulf districts, the central and west Gulf States receiving excessively heavy amounts. The rivers in northeastern Texas were swollen to flood stages by the heavy rains from the 16th to the 20th.

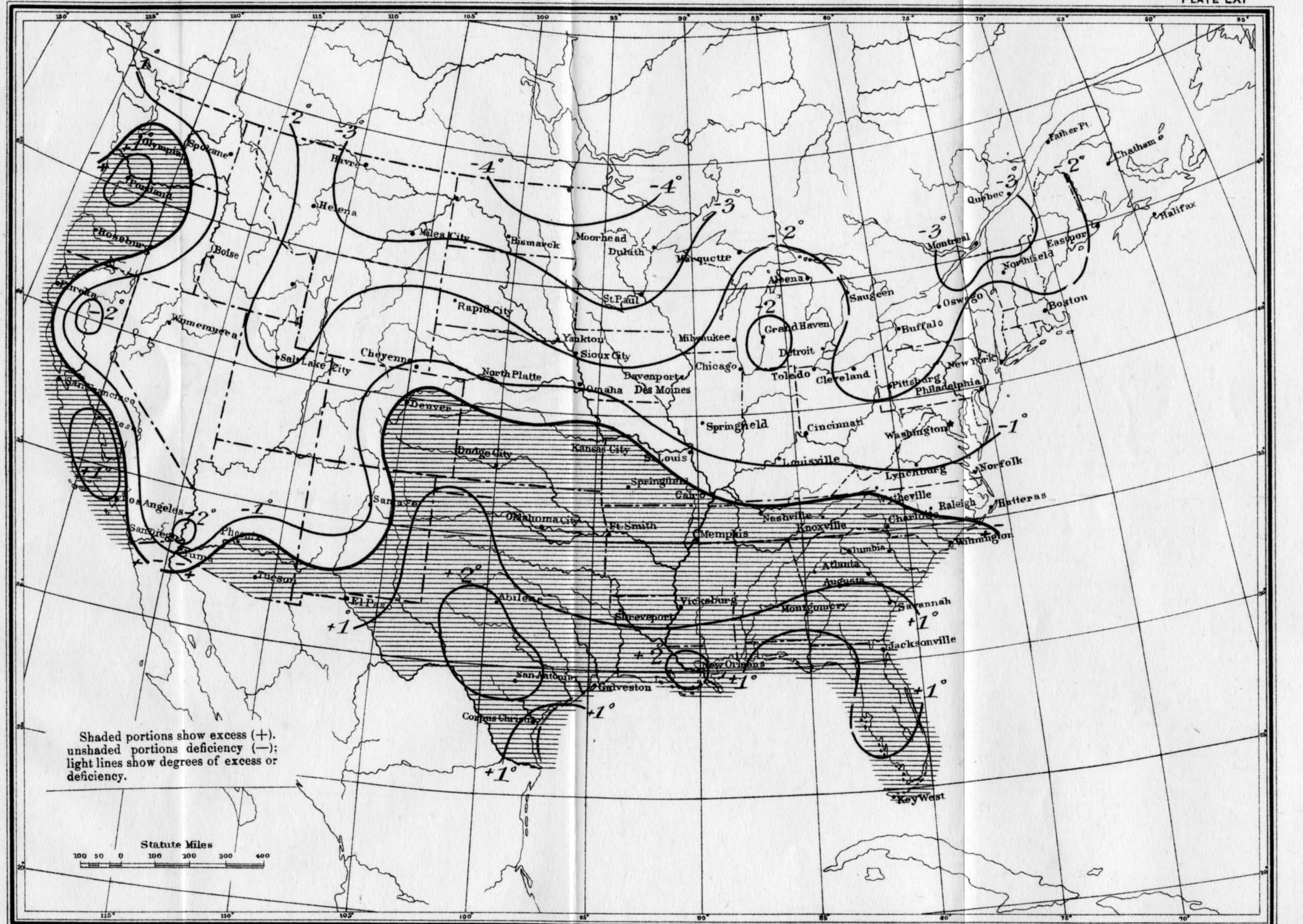
At the close of the month there was considerable snow on the ground in the interior of northern New England and over the northern portion of the upper Lake region, the greatest depths reported being 7 inches at Marquette, Mich., 6 inches at Northfield, Vt., and 5 inches at Sault Ste. Marie, Mich. Depths of snow ranging from trace to 1 inch were reported from the upper Mississippi and central Ohio valleys and over the higher portions of the Middle Atlantic States.

There was much more than the usual amount of sunshine in the Lake region and central valleys and generally throughout the Rocky Mountain and Pacific coast regions; the month was unusually cloudy in the Atlantic coast and Gulf districts.

December.

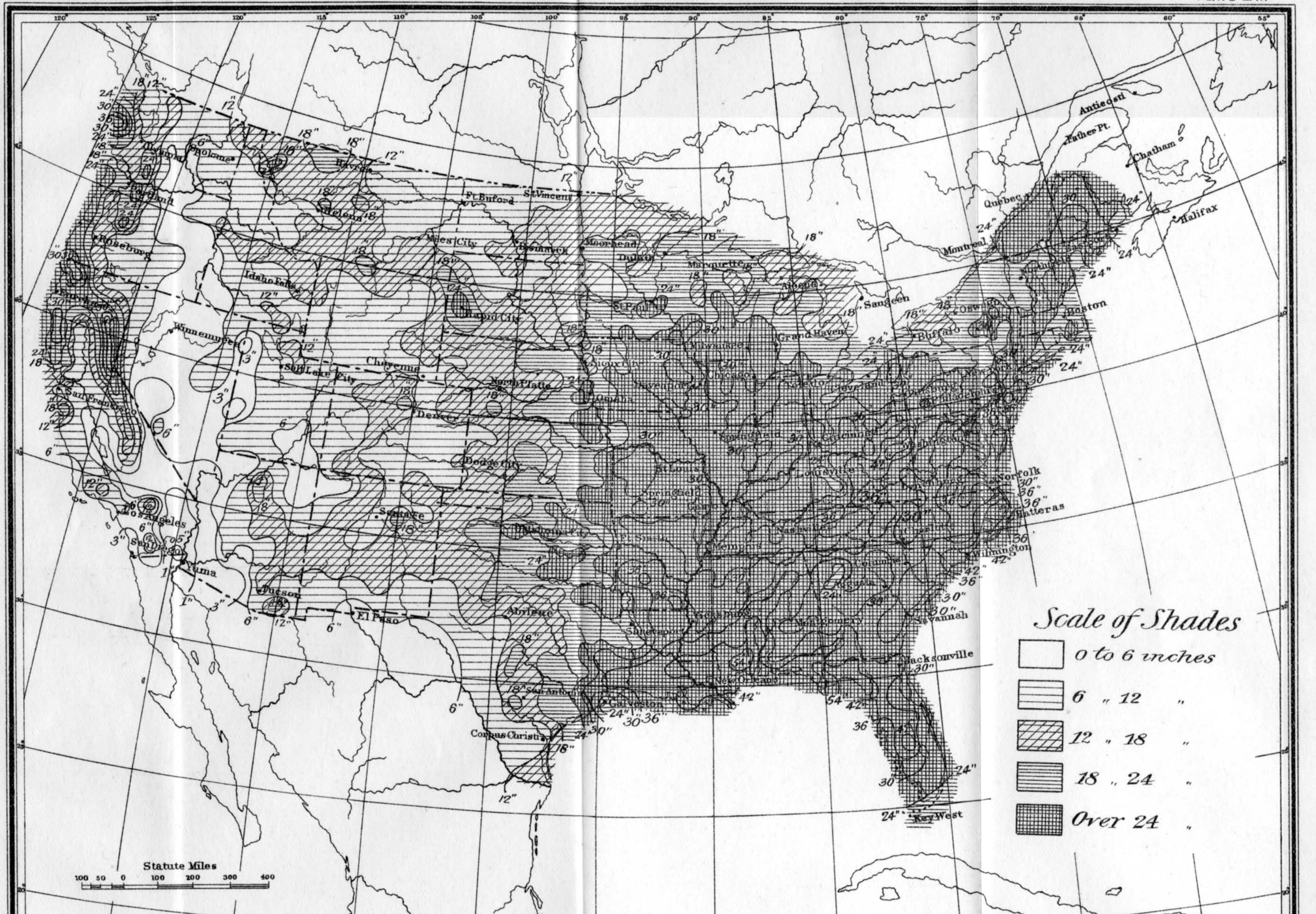
This month, as a whole, was very mild and exceptionally free from sudden and decided changes of temperature. The mean temperature of the last decade was so high that comparatively little ice had formed in the northern districts at the close of the month. Freezing temperatures extended southward to central Texas and to the east Gulf and south Atlantic coasts.

The precipitation was quite evenly distributed over most of the country east of the Rocky Mountains. The monthly amounts were less than the nor-



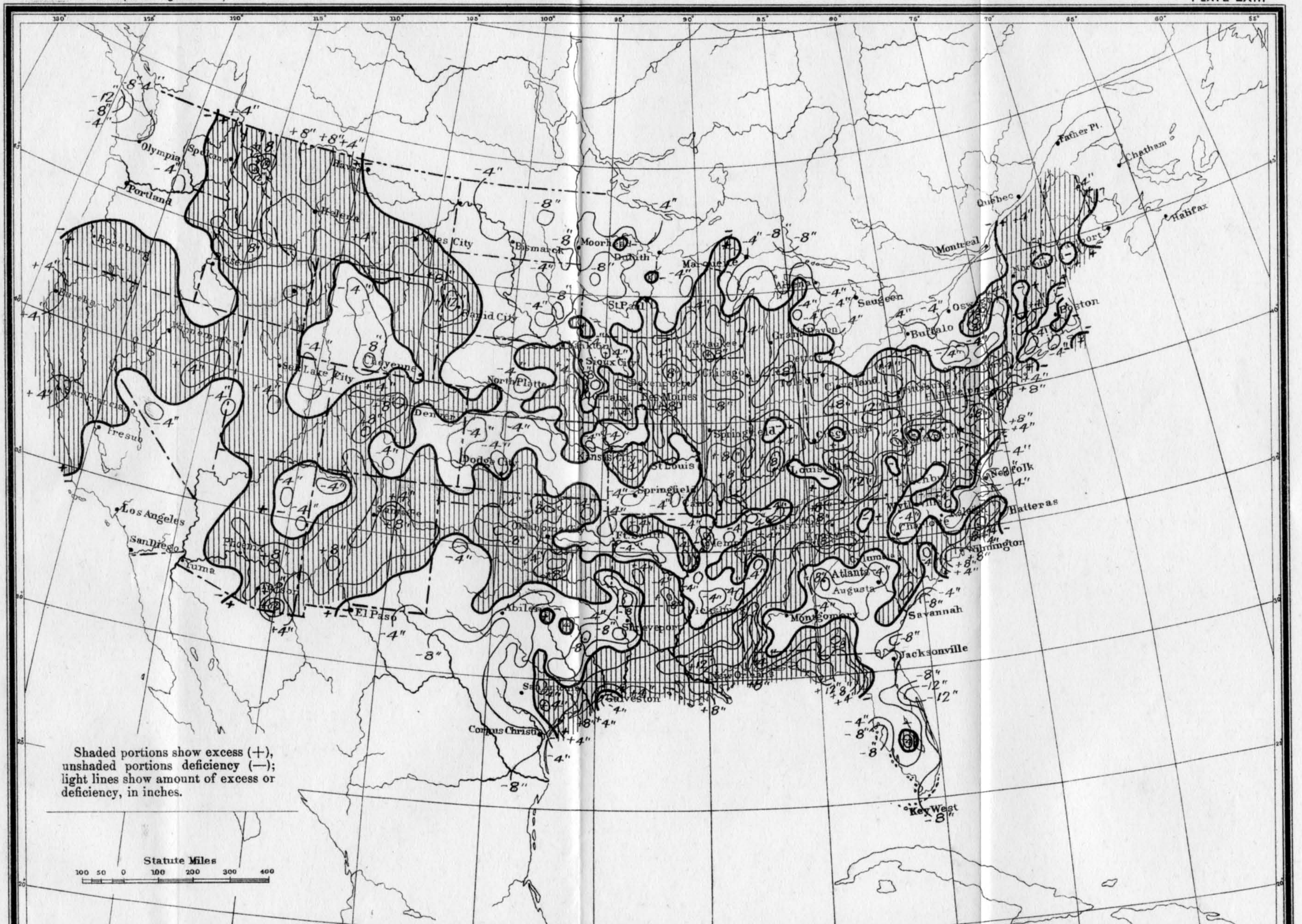
ANDREW. B. GRAHAM CO. PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

DEPARTURES FROM NORMAL TEMPERATURE FOR THE CROP SEASON OF 1907, FROM MARCH 1 TO SEPTEMBER 30.



ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

TOTAL PRECIPITATION FOR THE CROP SEASON OF 1907, FROM MARCH 1 TO SEPTEMBER 30.



Departures from Normal Precipitation for the Crop Season of 1907, from March 1 to September 30.

Andrew B. Graham Co., Photo-Lithographers, Washington, D. C.

mal in the Missouri and upper Mississippi valleys and interior of the central Gulf States, and generally in excess of the normal in the Atlantic coast and east Gulf districts.

On the north Pacific coast the month was unusually stormy and the precipitation was much in excess of the normal. In California the general conditions were nearly normal, except as to precipitation, which was largely deficient in the central and southern counties.

Description of Illustrations.

Plates LXI and LXIII show, respectively, the departures from the normal temperature and precipitation over the United States for the period from March 1 to September 30, and Plate LXII shows the total precipitation for the same period.

The diagrams (figs. 53 to 55) and the tables show the departures from normal temperature and precipitation by weeks for the several geographic districts—first, for the period from January 1 to April 1, and subsequently for each week ending with Monday until September 30.

Average daily departures from normal temperatures (degrees Fahrenheit), season of 1907.

Section.	From Jan. 1 to Apr. 1, inclusive.	For week ended— April— 8	15	22	29	May— 6	13	20	27
New England	−2.0	−3.9	−5.4	−6.3	−0.5	−3.5	−5.7	+1.6	−8.6
Middle Atlantic States	+0.9	−4.5	−9.0	−8.6	+0.4	−2.2	−4.5	+2.6	−7.8
South Atlantic States	+4.0	−6.4	−12.0	−5.3	+0.2	+2.2	+0.2	−0.9	−1.4
Florida Peninsula	+2.0	−4.3	−5.0	+1.7	+3.7	+3.0	+2.3	0.0	+2.0
Eastern Gulf States	+6.5	−1.4	−8.6	−5.3	−1.6	+0.9	−1.5	−4.0	+0.1
Western Gulf States	+7.8	+1.4	−2.5	−8.6	−3.4	−10.2	−1.8	−4.4	−1.2
Ohio Valley and Tennessee	+4.8	−2.8	−15.7	−12.0	−2.0	−5.5	−4.4	−1.4	−3.1
Lower Lake Region	+0.4	−3.4	−8.7	−9.9	−2.2	−7.2	−8.5	+1.1	−9.9
Upper Lake Region	+1.4	−1.2	−9.8	−7.7	−6.2	−9.2	−8.0	−3.3	−10.5
North Dakota	−1.0	0.0	−7.8	−9.8	−15.8	−15.4	−12.2	−10.8	−8.2
Upper Mississippi Valley	+4.3	−0.6	−11.4	−11.2	−5.7	−13.9	−5.1	−5.7	−5.9
Missouri Valley	+4.6	+3.0	−8.2	−12.8	−7.8	−14.7	−4.0	−6.7	−3.2
Northern Slope	+2.5	+4.2	+3.2	−7.8	−12.6	−10.8	−1.9	−1.8	−6.9
Middle Slope	+6.5	+4.7	−1.0	−13.2	−7.2	−17.7	−2.5	−3.7	−0.3
Southern Slope	+8.6	+3.8	+3.0	−7.2	−2.2	−10.8	−2.5	−4.0	−1.2
Southern Plateau	+2.6	−0.2	+9.0	−2.0	−1.7	−5.0	−4.7	−2.8	−3.3
Middle Plateau	+4.5	+1.7	+10.9	−2.1	+1.6	−4.0	−3.4	+0.3	−3.6
Northern Plateau	+1.9	−0.3	+5.3	−2.8	−4.8	−1.3	+0.2	+4.5	−3.5
North Pacific Coast Region	−0.9	−1.9	+1.6	+1.9	+0.3	+0.7	−0.3	+2.1	+1.7
Middle Pacific Coast Region	−0.2	−1.2	+4.5	+5.0	+0.2	−0.2	−2.0	+0.8	−0.5
South Pacific Coast Region	+1.2	−0.8	+4.0	+3.2	0.0	−0.5	−2.8	+2.0	−1.2

Section.	For week ended— June— 3	10	17	24	July— 1	8	15	22	29
New England	−1.0	−7.6	−5.5	+4.0	+0.5	−1.5	−1.6	+2.5	−1.1
Middle Atlantic States	−11.0	−6.8	−8.8	+1.5	−1.5	−1.6	+0.5	+1.2	+0.6
South Atlantic States	−5.4	−2.0	−3.4	−1.0	−0.8	−0.3	+1.7	+1.2	+2.7
Florida Peninsula	+1.0	+0.3	+1.7	−0.3	−1.3	−0.3	+0.3	+1.3	+0.7
Eastern Gulf States	−7.1	−0.4	−1.8	0.0	−0.3	+0.3	−0.2	+1.7	+3.2
Western Gulf States	−9.9	+1.3	+1.7	−0.2	+0.5	−0.8	−0.6	−0.2	+2.5
Ohio Valley and Tennessee	−10.4	−5.9	−3.7	+1.5	−3.5	−1.4	−0.1	+2.5	+0.8
Lower Lake Region	−11.4	−8.0	−4.8	+5.3	−1.8	−3.4	−2.7	+2.7	−2.0
Upper Lake Region	−6.3	−4.2	+1.3	+4.8	0.0	−2.5	+0.2	+1.8	−0.9
North Dakota	−2.8	−4.2	+1.0	+0.8	−3.0	+1.0	−3.8	−4.8	−3.2
Upper Mississippi Valley	−8.6	−6.4	−2.1	+1.9	−4.4	−0.4	−0.8	+1.2	−1.9
Missouri Valley	−9.0	−5.6	+2.2	−0.9	−3.5	+2.3	−2.2	−0.8	−1.8
Northern Slope	−3.3	−3.9	−2.4	−4.1	−3.8	0.0	−2.8	−4.3	−1.1
Middle Slope	−11.0	−2.3	+3.5	−2.2	−2.2	+2.3	−1.2	+1.8	+0.5
Southern Slope	−9.8	+2.8	+2.5	−3.2	+3.2	−1.2	−2.0	−1.2	+1.0
Southern Plateau	−5.3	−5.8	−8.3	−5.7	+0.2	+2.5	−1.0	−2.3	−3.0
Middle Plateau	−0.9	−4.1	−11.3	−5.4	−2.0	+2.3	−1.0	−2.0	−1.0
Northern Plateau	+3.2	−1.3	−12.3	−5.8	−0.3	−0.5	−1.2	−1.8	+0.7
North Pacific Coast Region	+3.0	+0.3	−4.0	+0.3	+1.1	+0.3	+0.4	−0.7	−0.9
Middle Pacific Coast Region	+8.0	−2.0	−5.5	−0.2	−1.5	−0.2	−0.8	−1.2	−1.8
South Pacific Coast Region	+1.5	−2.0	−3.2	−1.5	+1.2	+6.8	+0.2	−0.5	+0.5

Average daily departures from normal temperatures (degrees Fahrenheit), season of 1907—Continued.

Section.	For week ended—								
	August—				September—				
	5	12	19	26	2	9	16	23	30
New England	−2.0	+0.9	−0.5	−1.7	−3.6	+1.2	+4.0	+3.4	− 2.7
Middle Atlantic States	−2.2	+0.4	−0.8	−0.6	−2.4	+2.8	+2.5	+5.6	− 1.4
South Atlantic States	−0.5	+0.2	0.0	+1.6	+3.7	+2.6	+2.5	+5.0	+ 1.5
Florida Peninsula	+1.3	−0.3	0.0	+2.0	+1.7	+0.7	+1.0	+0.3	+ 1.7
Eastern Gulf States	−0.7	+1.9	+1.6	+1.2	+4.9	+2.5	+0.1	+3.4	− 0.1
Western Gulf States	−0.4	+3.6	+4.2	+2.6	+4.0	+4.2	−2.0	+5.1	+ 3.2
Ohio Valley and Tennessee	−5.1	+1.7	+0.5	−1.5	+2.9	−0.6	−0.2	+6.8	− 2.7
Lower Lake Region	−5.6	+1.2	−1.3	−1.9	−3.5	−0.9	+3.8	+3.6	− 5.8
Upper Lake Region	−5.2	+2.2	+0.9	−3.2	+0.8	−1.7	+3.3	+2.7	− 7.8
North Dakota	−6.2	+0.8	0.0	−2.5	−1.5	−2.2	−5.2	−2.0	−10.0
Upper Mississippi Valley	−6.6	+1.8	+0.9	−4.4	+6.1	−3.4	+1.8	+5.0	− 6.6
Missouri Valley	−6.3	+4.0	+2.0	−2.1	+6.2	−2.8	+0.7	+4.9	− 5.2
Northern Slope	−2.1	−2.3	−2.1	−1.7	−3.3	0.0	−3.8	−0.5	0.0
Middle Slope	−3.7	+4.3	+4.3	−1.2	+4.3	+0.7	+1.3	+4.3	+ 0.7
Southern Slope	+0.2	+3.5	+3.2	+2.0	+2.2	+3.8	−1.2	+4.5	+ 6.0
Southern Plateau	−0.5	+0.8	+1.2	−0.3	−5.3	+0.3	+1.2	−0.7	+ 0.8
Middle Plateau	+0.1	−1.9	+1.0	−0.1	−5.4	+0.7	+2.1	−3.0	+ 0.8
Northern Plateau	+3.0	−6.8	−4.5	−1.0	−8.8	−1.0	−0.7	−3.8	+ 2.8
North Pacific Coast Region	+2.9	−2.9	−1.0	+0.7	−1.9	+3.3	−0.3	+1.0	+ 2.0
Middle Pacific Coast Region	−0.2	−1.2	+1.0	−0.5	−3.8	+0.2	−2.5	−1.0	− 0.8
South Pacific Coast Region	0.0	−0.8	−1.0	+0.8	−2.2	+1.5	−1.2	−1.5	− 1.5

Departures from normal precipitation (inches and hundredths) season of 1907.

Section.	From Jan. 1 to Apr. 1, inclusive.	For week ended—							
		April—				May—			
		8.	15.	22.	29.	6.	13.	20.	27.
New England	−3.02	− .19	+.76	− .56	+ .26	−.07	+ .04	−.08	− .50
Middle Atlantic States	−3.46	− .14	+.47	− .51	+ .45	+.06	+ .49	+.06	− .35
South Atlantic States	−8.78	+ .06	−.47	+ .17	+ .70	−.09	+ .52	−.46	− .34
Florida Peninsula	−6.75	− .29	−.30	− .49	− .48	−.49	+ .81	−.49	− .64
Eastern Gulf States	−6.21	− .15	−.92	+1.97	+2.07	+.62	+1.09	+.78	+ .43
Western Gulf States	−3.71	+ .02	−.83	+ .90	− .31	+.77	+ .46	−.76	+ .47
Ohio Valley and Tennessee	+ .08	− .05	−.59	− .51	+ .24	+.34	+ .21	−.06	− .16
Lower Lake Region	− .12	− .18	−.20	− .47	+ .03	+.54	− .35	−.10	+ .36
Upper Lake Region	− .63	+ .10	−.05	− .40	+ .11	+.02	− .55	+.04	+ .60
North Dakota	+ .38	− .07	−.33	− .44	− .40	−.45	− .45	−.18	+ .36
Upper Mississippi Valley	+ .83	+ .12	−.60	− .56	− .10	+.26	− .59	−.14	+ .13
Missouri Valley	+ .33	− .23	−.54	− .48	− .37	+.04	− .65	−.19	+ .40
Northern Slope	− .03	− .20	−.35	− .19	+ .04	−.24	+ .10	−.14	+1.33
Middle Slope	− .70	+ .04	−.48	+ .03	− .24	+.91	− .64	−.57	− .40
Southern Slope	−1.15	− .18	−.35	+ .20	− .47	−.52	+ .26	−.49	− .61
Southern Plateau	+ .08	+ .14	−.11	+ .03	− .04	+.04	.00	−.08	− .09
Middle Plateau	+1.72	+ .23	+.02	− .02	− .20	+.21	+ .10	−.21	+ .33
Northern Plateau	+ .63	+ .30	−.21	− .21	− .28	−.35	− .10	+.23	− .20
North Pacific Coast Region	−4.18	+1.19	−.30	− .55	− .86	−.73	+ .38	−.32	− .54
Middle Pacific Coast Region	+6.22	+ .26	−.53	− .61	− .52	−.42	− .16	−.02	− .17
South Pacific Coast Region	+3.02	− .28	−.19	− .28	− .22	−.12	− .07	−.07	− .05

Departures from normal precipitation (inches and hundredths), season of 1907—Continued.

Section.	For week ended—								
	June—				July—				
	3.	10.	17.	24.	1.	8.	15.	22.	29.
New England	+ .27	− .20	−.69	−.33	+ .48	+.03	− .07	− .20	− .22
Middle Atlantic States	+ .61	− .28	+.12	−.47	+ .61	−.61	− .04	+ .20	− .77
South Atlantic States	+ .87	− .76	−.10	−.87	+1.07	−.57	+ .19	− .91	− .65
Florida Peninsula	+1.67	−1.42	−.60	−.68	+2.43	−.35	− .97	− .81	+1.41
Eastern Gulf States	+ .30	−1.02	−.46	−.89	− .17	−.44	+1.31	− .91	+ .18
Western Gulf States	+ .74	− .57	−.67	−.68	+ .44	−.29	+ .48	− .48	− .72
Ohio Valley and Tennessee	+ .31	+ .10	−.24	−.52	− .36	−.48	+1.05	+ .35	.00
Lower Lake Region	− .08	− .03	−.15	−.37	+ .14	−.60	+ .57	+ .04	+ .10
Upper Lake Region	− .75	+ .06	−.38	+.17	− .35	−.16	+ .04	+ .72	− .35
North Dakota	− .26	+ .66	−.21	−.29	− .48	−.33	+ .37	+ .54	− .48
Upper Mississippi Valley	− .23	+ .57	−.66	−.12	− .16	−.32	+1.43	+1.14	+ .22
Missouri Valley	− .33	+ .96	−.35	+.03	− .10	−.62	+1.29	+ .21	+ .07
Northern Slope	− .21	− .03	−.16	+.55	− .21	+.07	+ .23	+ .19	+ .30
Middle Slope	+ .34	+ .17	−.69	+.30	+ .43	−.66	− .30	− .63	+ .97
Southern Slope	+ .47	− .52	−.29	+.37	− .66	+.01	+ .79	− .64	− .39
Southern Plateau	+ .23	+ .08	+.06	+.11	− .12	−.12	− .01	− .20	+ .23
Middle Plateau	+ .13	+ .10	+.12	+.26	− .06	−.16	− .09	− .13	+ .45
Northern Plateau	− .33	− .19	+.62	+.01	− .07	+.03	+ .13	+ .08	− .02
North Pacific Coast Region	− .54	− .06	+.14	−.42	− .25	+.31	− .16	− .09	− .08
Middle Pacific Coast Region	− .20	− .02	+.58	.00	− .04	−.01	− .07	.00	.00
South Pacific Coast Region	− .05	− .03	+.08	.00	.00	.00	.00	.00	+ .01

Section.	For week ended—								
	August—				September—				
	5.	12.	19.	26.	2.	9.	16.	23.	30.
New England	− .25	− .79	− .86	− .36	− .49	+1.67	− .42	− .09	+2.74
Middle Atlantic States	− .24	+ .07	− .74	+ .02	− .67	+ .63	+ .26	+ .87	+1.20
South Atlantic States	+ .22	− .04	+ .12	− .38	− .99	+ .38	− .32	− .16	+1.22
Florida Peninsula	−1.37	− .01	− .44	−1.17	−1.15	−1.06	+1.29	− .02	+ .36
Eastern Gulf States	− .29	+ .02	− .22	− .17	− .69	+ .03	+ .11	+ .97	+1.02
Western Gulf States	− .54	− .70	− .30	− .20	− .53	− .56	− .01	− .24	− .58
Ohio Valley and Tennessee	− .44	− .26	+ .05	+ .41	− .31	+ .13	+ .18	+ .51	− .21
Lower Lake Region	− .08	− .45	− .53	− .47	− .26	+ .07	+ .20	+ .09	+1.05
Upper Lake Region	− .03	− .29	+ .47	− .18	− .04	− .03	+ .19	+ .92	+ .12
North Dakota	+ .26	− .21	− .24	− .35	+ .08	− .29	+ .08	+ .57	− .24
Upper Mississippi Valley	− .19	+ .70	+ .83	− .15	+ .57	− .27	− .44	+ .42	+ .12
Missouri Valley	− .12	− .36	− .28	+ .02	+ .01	− .47	− 64	− .05	− .06
Northern Slope	+ .06	− .20	− .20	− .19	+ .43	− .12	− .05	− .15	+ .19
Middle Slope	− .11	− .40	+ .36	+ .03	− .08	− .13	− .51	− .31	+ .08
Southern Slope	+ .04	− .53	− .35	+ .80	− .15	− .41	− .64	− .37	− .60
Southern Plateau	+ .28	− .33	+ .03	+ .23	+ .23	− .02	− .18	− .05	− .28
Middle Plateau	+ .16	− .15	+ .05	+ .10	+ .27	− .01	− .12	− .11	− .17
Northern Plateau	+ .09	+ .23	− .08	+ .35	+ .35	− .10	− .07	− .07	− .12
North Pacific Coast Region	− .03	+ .31	− .14	+ .18	.00	− .32	+ .80	− .43	− .46
Middle Pacific Coast Region	.00	+ .67	.00	.00	− .03	− .03	− .10	− .14	− .19
South Pacific Coast Region	.00	.00	.00	.00	.00	+ .02	− .01	− .07	− .13

THE PRINCIPAL INJURIOUS INSECTS OF THE YEAR 1907.

Insects Injurious to Cotton and Other Southern Field Crops.

The boll weevil (*Anthonomus grandis* Boh.) has continued its spread northward and eastward. During the season the northern limit of infestation in Oklahoma was pushed out about 60 miles and about the same spread was experienced in a northeasterly direction in Arkansas. During the summer the weevil crossed the Mississippi River, and in the fall it was found in three of the western counties of Mississippi. The mild winter of 1906 permitted an unusually large percentage of survival among hibernating weevils, and had it not been for the hot dry summer there is no doubt but a much greater loss would have been experienced. A conservative estimate of the damage to the crop of 1907 would place the loss at 415,000 bales, or about $25,000,000.

Injury to cotton from the bollworm (*Heliothis obsoleta* Fab.) was not as severe as during 1906; although certain localities suffered heavy loss, the dry summer months hastened the maturity of the crop and at the same time effectually checked the bollworm ravages.

The cotton square borer (*Uranotes melinus* Hbn.) appeared in practically all sections of the cotton belt and did more or less injury by boring into the tops of the growing plants and eating out the early squares and a few of the small bolls.

The cotton aphis (*Aphis gossypii* Glov.) did some damage to young cotton during the cold wet spring, but was soon destroyed after warm weather began by its numerous natural insect enemies. Its occurrence in numbers upon the tops of cotton plants in certain portions of Arkansas was reported early in August.

The cotton-leaf caterpillar (*Alabama argillacea* Hbn.) appeared in limited numbers in southern Texas and in the lower Red River bottom late in the fall.

The garden webworm (*Loxostege similalis* Guen.) occurred quite commonly on cotton in all parts of Texas.

The tobacco thrips (*Euthrips nicotianæ* Hinds) did considerably more injury in 1907 than in 1906 on account of favorable climatic conditions.

The Argentine ant (*Iridomyrmex humilis* Mayr) is still spreading northward in Louisiana, and though of primary importance as a household pest it is indirectly responsible for increased injury by certain aphides and by the mealy-bug on cane. It is also of importance as a horticultural pest, doing much injury by eating the petals of cut flowers and eating into the fruit buds of orange, fig, etc.

The tobacco flea-beetle (*Epitrix parvula* Fab.) occasioned unusual damage to seed beds throughout the dark-tobacco belt of Kentucky and Tennessee. The loss due to lessened acreage is approximately $2,000,000.

The tobacco worms (*Phlegethontius quinquemaculata* Haw. and *P. sexta* Joh.) caused a loss of at least 10 per cent of the crop, or fully $800,000. This loss would have been much greater had it not been for the more general use of arsenites on the crop.

The following species damaged tobacco in the dark-leaf region, though not to an alarming extent: *Melanoplus atlanis* Riley, *M. differentialis* Thos., *Œcanthus quadripunctatus* Beut., *Heliothis obsoleta* Fab., *Chloridea virescens* Fab., and several species of cutworms. Of these insects the cutworms did the greatest damage.

Insects Affecting Cereal and Forage Crops.

Probably the most destructive outbreak of the year was that of the spring grain-aphis (*Toxoptera graminum* Rond.). This pest occurred in the East from South Carolina and Georgia to Pennsylvania, Ohio, and central Indiana. In the West, from Texas north, following the Arkansas River Valley, it spread into Colorado, across Kansas and eastern Nebraska, seeming to follow the Mississippi Valley, and down the valley of the Red River of the North into Canada. Its area of destruction, however, includes the Carolinas, Texas, Oklahoma, and Kansas, though some damage was done in Missouri and Iowa. The damage done by the pest over this entire country probably amounted to several millions of dollars.

There is every indication of a serious outbreak of the Hessian fly (*Mayetiola destructor* Say) in northern Oklahoma and southern Kansas. The area of greatest abundance of the pest includes Harper, Sumner, Cowley, Kingman, Sedgwick, Reno, and Harvey counties, Kansas; Alfalfa, Garfield, Grant, Kay, Pawnee, Tulsa, Craig, and Wagoner counties, Oklahoma. The outlook is all the more discouraging in this section because of the seemingly entire absence of parasites. There is also an outbreak in western Washington about Vancouver.

The chinch bug (*Blissus leucopterus* Say) is dangerously abundant from Texas northward through Oklahoma and central Kansas to Nebraska. Reports of serious damage have come from Ponca City and Seiling, Okla., and in Sumner County, Kans. Whether this outbreak will increase in seriousness or not will of course depend wholly on weather conditions the coming spring, as rainy weather during the breeding season is fatal to the young bugs.

A serious outbreak of what was probably the wheat-straw worm (*Isosoma grande* Riley) has occurred in eastern Washington, some of the wheat fields

having been so seriously damaged that they were found not worth harvesting. Either the same or another species of Isosoma infested wheat about Vancouver, Wash.

The army worm (*Heliophila unipuncta* Haw.) was destructively abundant in many localities from Kentucky and Missouri northward to New England. In many cases reports of army worm proved on investigation to be due to the variegated cutworm (*Peridroma margaritosa* Haw. [*saucia* Hbn.]). As is often the case with this species, it took on somewhat the army worm habits, and this year seriously ravaged the clover and alfalfa fields, especially in the West.

Another cutworm (*Chorizagrotis auxiliaris* Grt.) committed very serious ravages in Montana in the spring, thousands of acres of wheat being totally destroyed in April and May.

The fall army worm (*Laphygma frugiperda* S. & A.) was especially destructive in the alfalfa fields in Virginia, Missouri, Texas, and Kansas. In a single county in Missouri the loss was estimated at $75,000. The same pest attacked violets at Athens, Ga., and destroyed young sorghum in Kansas and rice in North Carolina.

In Louisiana and Texas the sorghum heads were attacked by a small midge (*Cecidomyia* [*Diplosis*] *sorghicola* Coq.), and rendered sterile so that no seed was produced.

One of the aphides (*Chaitophorus flavus* Forbes) seriously injured timothy in West Virginia; also, other grasses about Washington and in the West.

Anaphothrips striatus Osborn, a species of thrips, seriously damaged oats in Michigan.

Root webworms (*Crambus* sp. (?)) were very destructive in fields of corn in the vicinity of Waterford, Pa.

Alfalfa was seriously damaged about Clarendon, Tex., by a small leaf-hopper (*Agallia sanguinolenta* Prov.), which caused the leaves to blight and turn yellow in May.

The clover-seed chalcis (*Bruchophagus funebris* How.) seriously affected growing alfalfa seed in California. This same pest attacks alfalfa seed in Siberia and Turkestan.

There were serious outbreaks of grasshoppers about Coulee City, Wash., and Vistillas, Oreg. In the former locality they were destroyed in myriads by a tachinid fly.

The garden flea-hopper (*Halticus uhleri* Giard) was destructive to alfalfa about Topeka, Kans.

The corn root-aphis (*Aphis maidi-radicis* Forbes) was reported injurious to young corn in southern Indiana, West Virginia, Maryland, Kentucky, and Illinois.

The corn delphax (*Peregrinus* [*Delphax*] *maidis* Ashm.) was reported as doing much damage to summer-planted corn in certain parts of southern Texas. The injury was probably not as severe as in 1906.

The rose-chafer (*Macrodactylus subspinosus* Fab.) was reported with specimens as having destroyed a 60-acre field of corn near Kankakee, Ill., in June. The same trouble was reported also from Bryantville, Mass.

A small mite (*Notophallus dorsalis* Banks) did considerable injury to a meadow of orchard grass near Midlothian, Va., and was also observed on wheat at Sharpsburg, Md. In Virginia it was suppressed by the application of kerosene emulsion.

Insects Injurious to Truck and Vegetable Crops.

The common asparagus beetle (*Crioceris asparagi* L.) was reported to be destroying asparagus in Delaware, Illinois, New Jersey, New York, and in portions of Michigan and Maryland.

The bean and pea weevils.—Owing to the almost universal use of bisulphid of carbon as a means of fumigating leguminous seeds affected by weevils, few reports of injuries are received in comparison with earlier years. The bean weevil (*Bruchus obtectus* Say) was reported troublesome in Massachusetts, New York, Pennsylvania, Ohio, Illinois, and Nebraska. The pea weevil (*Bruchus pisorum* L.) in one locality in California destroyed about 90 per cent of the pea crop. Two foreign species not hitherto identified with injury to edible legumes have been shipped in beans and peas from India and there is danger of their introduction into this country.

The cowpea-pod weevil (*Chalcodermus æneus* Boh.) was noticed injuring beans in Florida, cowpeas and cotton in southeastern Missouri, and cotton in North Carolina and Louisiana.

The pea aphis (*Macrosiphum pisi* Kalt. [*Nectarophora destructor* Johns.]) was rather more abundant than usual, its range of destructiveness, although local, being most marked in central and western New York, Maryland, Virginia, and the District of Columbia. It made its first appearance in Louisiana in 1907.

The beet webworm (*Loxostege sticticalis* L.) was reported doing considerable damage early in the year in some portions of California.

The greenhouse leaf-tyer (*Phlyctænia ferrugalis* Hbn.) was injurious to sugar beet in California, and to chrysanthemums growing in greenhouses in Boulder, Colo., being very abundant and very destructive in the last region.

The spinach leaf-miner (*Pegomya vicina* Lint.) was, as usual, injurious to sugar beet in portions of Utah and California.

The pale-striped flea-beetle (*Systena blanda* Mels.) was destroying beans in the vicinity of the District of Columbia. What is considered the same species was found attacking sugar beet somewhat extensively in southern California.

The tarnished plant-bug (*Lygus pratensis* L.) was observed attacking sugar beet in Utah and dahlia in Maine; otherwise it was a subject of little complaint.

The harlequin cabbage bug (*Murgantia histrionica* Hahn) has been reported from so many localities during the year that there is prospect of its spreading any year northward where it was formerly a pest but where it has not been injurious for several seasons owing to atmospheric conditions unfavorable to its hibernation. Complaints of injury have been particularly numerous from Texas and Kansas, while the species has been abundant in the Norfolk region of Virginia.

The imported cabbage worm (*Pontia rapæ* L.) did its customary amount of injury.

The cabbage looper (*Autographa brassicæ* Riley) was troublesome during the year, although not as widely distributed as several years ago. Injuries of particular severity were reported in California, Florida, and Texas, and locally in Virginia and Indiana. Besides cabbage and other crucifers it attacked tomatoes, beets, and cucumber, and was very destructive to lettuce, especially when grown indoors.

The cabbage aphis (*Aphis brassicæ* L.) was very injurious to cabbage in the West, particularly in Wyoming, New Mexico, and California. Injury to rutabaga was also reported near Philadelphia, Pa.

The imported cabbage webworm (*Hellula undalis* Fab.) has extended its range and now occurs injuriously in North Carolina and in less numbers in Florida, two States in which it has not been previously observed.

The green fly or turnip aphis (*Rhopalosiphum dianthi* Schrank) has been very abundant in Virginia; at Blacksburg it was troublesome on rose; in the Norfolk trucking region it attacked eggplant in hotbeds and has become a serious menace to the culture of spinach, one of the leading crops of that region. A study of the insect must be made to ascertain what can be done toward controlling it. In the District of Columbia this species occurred in abundance on radish, water cress, cucumber, and peppermint.

The diamond-back moth (*Plutella maculipennis* Curt.) attracted attention on cabbage from North Carolina to Florida, Georgia, and Texas, cabbage, collards, and turnip being affected.

The melon aphis (*Aphis gossypii* Glov.) continues to be one of the most important truck-crop pests of the country. During the year it was reported especially abundant in Texas; also in Florida, Arkansas, Arizona, and New Mexico. Melon and other cucurbits were most injured, but cotton, turnip, rhubarb, and okra were also affected. Injury, probably due to this species, was reported from Minnesota and Oregon.

The squash-vine borer (*Melittia satyriniformis* Hbn.) was somewhat generally destructive from Long Island to Buffalo in New York State, in northern Ohio, and in Virginia and West Virginia, to squash and in some cases to cymlings and cucumbers.

Of the squash bug (*Anasa tristis* DeG.) few complaints were received as compared with former years. The species seemed to attract most attention in the northern States, especially in Michigan.

The pickle worm (*Diaphania nitidalis* Cram.) was injurious to squash and cantaloupe in Alabama, Florida, and in some portions of Virginia. The related

melon worm or caterpillar (*Diaphania hyalinata* L.) was reported injurious to cucumbers in southern California in February and in central Florida in November.

The squash ladybird (*Epilachna borealis* Fab.) was the subject of more complaint than in many years. It was abundant in Maryland, Virginia, Kansas, Arkansas, and Pennsylvania, attacking cucurbits of various kinds, including squash, pumpkin, chayote, and melons.

The striped cucumber beetle (*Diabrotica vittata* Fab.), always a pest on cucurbits, was somewhat local in its injuries, judging from reports, which were numerous.

The Southern corn root-worm (*Diabrotica 12-punctata* Ol.) was not reported from many localities, but in portions of Maryland and Virginia was quite troublesome, especially on cucurbits. The related *D. soror* Lec. did considerable damage to cucurbits and various other truck crops in California, the list of plants including cabbage, beans and peas, zinnias, daisies, and other ornamental plants. *D. balteata* Lec. was observed, together with *D. picticornis* Horn attacking squash and cotton at San Antonio, Tex., and *D. connexa* Lec. infested squash and other cucurbitaceous plants at Corpus Christi, Tex.

The corn-ear worm or tomato fruit worm (*Heliothis obsoleta* Fab.) was about as troublesome as usual to sweet corn and tomato and somewhat generally throughout the South, as also in portions of Pennsylvania and New Jersey. In Ohio the species was abundant even in the northern part of the State.

The Colorado potato beetle (*Leptinotarsa decemlineata* Say) was somewhat unusually local during the year 1907, injury being reported from northern Minnesota, some portions of Kansas, where it was more abundant than usual, Wisconsin, Michigan, and the Norfolk region of Virginia. In northern Virginia, Maryland, and the District of Columbia the species, on the other hand, was extremely rare.

The Southern leaf-footed plant-bug (*Leptoglossus phyllopus* L.) was moderately injurious to tomato in South Carolina, to eggplant and kumquat in Florida, and to cotton in Louisiana.

The green plant-bug (*Nezara hilaris* Say) was abundant in South Carolina and Florida, in the former State injuring tomatoes.

The tomato worms (*Phlegethontius sexta* Joh. and *P. quinquemaculata* Haw.) were extremely abundant and injurious over a wide stretch of territory extending from the neighborhood of New York City and in Connecticut southward through Maryland, Virginia, and the District of Columbia, as also in Kansas.

The sweet-potato borer (*Cylas formicarius* Fab.) was found in a large percentage of sweet potatoes exposed for sale in the markets of Houston, Tex. It was injurious in other portions of Texas and in Louisiana as always.

The garden flea-hopper (*Halticus uhleri* Giard) was reported attacking eggplant in Florida and beans in Virginia and Illinois.

The common stalk-borer (*Papaipema nitela* Guen.) was comparatively rare. It was observed attacking the usual class of plants—corn, beets, and ornamentals—in isolated localities in New York, New Jersey, and Maryland.

The potato tuber worm (*Phthorimæa operculella* Zell.), probably the most important enemy to the trucking industry of California, accomplished a large amount of damage.

Cutworms, always the subject of much complaint, were more numerous than in most years. Of the variegated cutworm (*Peridroma margaritosa* Haw. [*saucia* Hbn.]) the year 1907 witnessed a moderately severe outbreak in many portions of the country. The insects were very abundant in Maryland, Virginia, District of Columbia, California, Texas, Arizona, Missouri, Tennessee, Indiana, Illinois, Washington, Ohio, New York, Pennsylvania, Massachusetts, Vermont, and West Virginia, attacking practically all forms of truck crops and ornamental plants, as also injuring crops such as onion, tobacco in Tennessee, clover in Indiana, etc. The black cutworm (*Agrotis ypsilon* Rott.) was injurious in the neighborhood of Norfolk, Va., especially to eggplant. The clandestine cutworm (*Noctua clandestina* Harr.) was troublesome in Maryland, doing particular damage to cabbage. The spotted cutworm (*Noctua c-nigrum* L.) was injurious in Pennsylvania. The glassy cutworm (*Hadena arctica* Bdv.) was identified with injury to sugar beet in Utah. Another cutworm (*Prodenia eridania* Cram.) appeared as a pest in several portions of Florida, attacking such truck crops as were growing during the season.

White grubs and their parents, the May and June beetles, caused the usual amount of injury. White grubs were very troublesome in portions of Illinois. At Bloomington the soil was described as full of them in sod land broken the previous fall. At Key West, Fla., they were reported boring holes in sweet potatoes, causing them to rot. The green June beetle (*Allorhina nitida* L.), although chiefly injurious on lawns, is reported to have done considerable injury in flower gardens and also to vegetables in Illinois, Missouri, and on Long Island.

Of wireworms, a somewhat unusual number of complaints were received from localities in the States of New York, Pennsylvania, Massachusetts, Connecticut, Indiana, Ohio, Maine, and California. Injury to sweet potatoes was very pronounced, as also to grapes, cucumbers, eggplant, and cauliflower; pansies were also injured. The wheat wireworm (*Agriotes mancus* Say) was identified with injury to a large acreage of peppermint grown commercially at Niles, Mich.

Red spiders were not as abundant as in 1906. There was local injury, however, to greenhouse eggplant in the Norfolk region of Virginia, to Lima beans in northern New Jersey, and to wistaria and morning-glory in the District of Columbia. Violets suffered severely in southern California. Other injury was reported on Long Island and at Augusta, Ga. *Tetranychus bimaculatus* Harv. was the prevalent species.

The root-maggots were decidedly inconspicuous during the year as compared with several preceding seasons. The cabbage maggot (*Pegomya brassicæ* Bouché) was destructive in Pennsylvania and Massachusets; the onion maggot (*P. cepetorum* Meade) in Massachusetts, New York (especially on Long Island), New Jersey, northern Illinois, and southern Indiana. The seed-corn maggot (*P. fusciceps* Zett.) was injurious to a variety of truck crops, including onion, corn, peas, beans, cabbage, and turnip, from the District of Columbia, Maryland, and Virginia southward to North Carolina, as also in New York, Michigan, and in Alaska. A root-maggot hitherto unknown as injurious (*P. planipalpis* Stein) was reported attacking radish and doing some injury in the vicinity of San Francisco, Cal.

Thrips did very considerable damage generally from the Atlantic to the Pacific States and southward in the Gulf region. The onion thrips (*Thrips tabaci* Lind.) was the prevalent form and was the cause of extensive injury to onion practically throughout the State of Texas, where this crop is grown commercially; a universal outbreak was reported for that State. Similar injury was complained of in the principal onion districts of Massachusetts and Connecticut, and in Louisiana. Greenhouse cucumbers were injured in the District of Columbia and complaints were also received of injuries in Illinois and Mexico. The strawberry thrips (*Euthrips tritici* Fitch) was injurious to roses in Missouri and Pennsylvania. Thrips injury was reported to lettuce and croton in Florida, to potato in Texas, and to beets in Utah. Other forms of thrips did some injury to sugar beet.

Insects Injurious to Deciduous Fruits.

The season of 1907 was not marked by any unusual or widespread outbreak of insects destructive to deciduous fruits. The character of the winter was apparently unfavorable to the hibernation of numerous species, and the lateness of the spring delayed their appearance in many sections from two to three weeks or more beyond the usual time. The great reduction of fruit from late cold, amounting to practically complete destruction in portions of the Middle West, undoubtedly greatly lessened the multiplication of fruit-feeding species, and it would appear that these should be much less abundant another season than for some years past.

The codling moth (*Carpocapsa pomonella* L.) has occasioned about the usual amount of injury in regions where there was an apple crop. The almost entire absence of fruit over large areas in the Middle West, as in southeastern Nebraska, portions of Missouri, and Kansas, presents an interesting condition relative to the possible effect of the absence of usual food in starving out this species, as it is not known to be able to subsist on the foliage and twigs of the apple, though sufficient native wild fruits may have been at hand to maintain the species in some numbers.

The apple maggot (*Rhagoletis pomonella* Walsh) has been complained of about as in past years, principally from the New England States, where its injuries one year with another are quite severe. Fortunately the spread of the species continues to be very slow.

The lesser apple worm (*Enarmonia prunivora* Walsh) has been shown by the Bureau of Entomology to be a serious enemy of the fruit of the apple, ranking in importance close to the codling moth. Its injuries for the past two or three years have been constantly increasing. It is known to occur quite generally over the United States eastward of the Rocky Mountains, and it occurs in British Columbia and eastern Canada.

A lepidopterous larva belonging to the genus Marmara was found in apples from Arkansas, and also from Niagara County, N. Y., making long winding linear mines just under the skin of the fruit, greatly disfiguring it and reducing its keeping qualities. Similar injury has been previously noted and illustrated by this Bureau (Bul. 10, n. s., p. 87), and mines of this same general appearance have been frequently observed under the bark of apple shoots, and twigs showing similar injury have been received from Massachusetts.

The trumpet leaf-miner of the apple (*Tischeria malifoliella* Clem.), much in evidence during the past two or three years in the vicinity of Washington, was but little noticed during 1907, and no complaints were received of its presence where formerly it had been abundant.

Canker-worms (*Paleacrita vernata* Peck and *Alsophila pometaria* Harr.) were apparently largely destroyed by the cold weather of late spring, as no complaints whatever concerning them were received.

The apple-tree tent caterpillar (*Malacosoma americana* Fab.) was but little complained of during 1907, though it was observed to be excessively abundant over a limited area west of Charlottesville, Va.

The apple leaf-folder (*Ancylis nubeculana* Clem.) has been reported as quite abundant in Cattaraugus County, N. Y.

A tussock moth (*Hemerocampa vetusta* Bdv.), previously noted as destructive to orchards in Washington State, has been much in evidence during the past two or three years in the Pajaro Valley, in California, the larvæ defoliating apple orchards, the younger individuals eating into the small green fruit.

The cherry-tree tortrix (*Archips cerasivorana* Fitch) has been abundant on wild cherries in Maine, and nests and larvæ were received from Ohio during late June.

The cherry leaf-beetle (*Adimonia cavicollis* Lec.) was reported destructive to cultivated cherries in Michigan and the species has also been noted on wild cherries in Maine.

A sawfly (*Pamphilius persicum* MacG.), noted last year as an enemy of peach in Connecticut, has increased in destructiveness, and has been studied at the Connecticut Agricultural Experiment Station.

The plum curculio (*Conotrachelus nenuphar* Hbst.) in some sections was quite destructive to apples and in several instances observed, by its concentrated attack on peaches, quite destroyed the small crop which had survived late spring frosts.

An aphis (*Myzus persicæ* Sulz.) has become unusually abundant on peach in Colorado, where it has been carefully studied at the Colorado Agricultural Experiment Station.

The pear thrips (*Euthrips pyri* Daniels), which has been very destructive to deciduous fruits in the Santa Clara Valley in California for the past two or three years, while much in evidence during the spring of 1907, was less abundant than formerly. The insect has been noted in other parts of the State, which indicates its gradual spread.

The grape root-worm (*Fidia viticida* Walsh) continues to be seriously destructive in the Erie Grape Belt, in vineyards where remedial measures in its control are neglected. The increasing use by vineyardists of arsenical sprays, supplemented by timely cultivations, has resulted in marked improvement in vineyards where these practices are followed. The beetles were three or four weeks later than usual in putting in their appearance, emerging practically over the entire summer.

Adoxus vitis L. is stated to have become a grape pest of importance in portions of California, and has been investigated at the California Agricultural Experiment Station.

The grape root-borer (*Memythrus polistiformis* Harr.) has been quite destructive in portions of West Virginia.

The grape plume moth (*Oxyptilus periscelidactylus* Fitch) was reported as destructive in localities in Massachusetts, and also in Connecticut.

The social grape caterpillar (*Harrisina americana* Harr.) was abundant in the environs of New Orleans, and also in the vicinity of Washington, in Maryland, and in Virginia.

Allorhina mutabilis Gory was complained of as a serious enemy of grapes in Arizona, feeding in numbers on the fruit.

Scale insects of the orchard have attracted about the usual amount of attention during the year. Information concerning their control is becoming more and more general; the San Jose and other armored scales are being kept well in check by proper use of the lime-sulphur wash, and the use of this insecticide and fungicide is constantly increasing. Frequent complaints have been received from Maryland and Pennsylvania concerning infestation of peach orchards by the terrapin scale. (*Eulecanium nigrofasciatum* Perg.), and this pest has been investigated at the Maryland Agricultural Experiment Station. The oyster-shell scale (*Lepidosaphes ulmi* L.) and the scurfy scale (*Chionaspis furfura* Fitch) have been but little complained of, and have been apparently less troublesome than in recent years.

INSECTS INJURIOUS TO CITRUS AND OTHER TROPICAL FRUITS.

The citrus white fly (*Aleyrodes citri* R. & H.) has continued to extend its range in the orange groves of Florida. The three important fungous diseases which attack this insect are able, where well established, to bring it into complete subjection once in three years only; in other words, one year in three the fruit is clean and requires no washing. The next year, the fungus having in the meantime disappeared, the white fly reappears and developes enormously with little check. Toward the end of this year, however, the fungus again begins to operate, and finally overtakes and practically exterminates the white fly during this and the following year, but does not prevent during these two years the blackening of foliage and fruit.

During the past year this white fly, long feared in California, was found to have established itself at two widely separated points, namely, north of Sacramento in the neighboring towns of Marysville and Oroville, and near the southern end of the San Joaquin Valley at Bakersfield. The State board of horticulture of California has taken vigorous hold of these points of infestation, and if extermination be possible, the thorough work being done by the board will accomplish it.

The common scale-insect pests of citrus trees have about the same status as in previous years. A good many new enemies are being reported for other subtropical plants, notably for the cocoanut palm. A species of Brassolis, probably *B. isthmia* Bates, was reported to have entirely defoliated a number of palms at Ancon, in the Canal Zone, Panama, in some cases damaging the trees beyond recovery. Where it was possible to spray with arsenate of lead, very satisfactory control was obtained. Another lepidopterous insect, probably *Opsiphanes crameri* Feld., is reported as doing similar injury to the cocoanut palm at Port Limon, Costa Rica.

The date plantings in Arizona and California are being more or less seriously injured by the attacks of the two imported date scale insects, *Parlatoria blanchardi* Targ., and *Phœnicococcus marlatti* Ckll. The former has resisted all efforts at control by sprays or fumigation, but has been brought into pretty effective check in Arizona by the use of a gasoline flame applied very rigorously to the trunks and leaf stubs of trees which have been previously cut back to the bud. The ability to withstand heat or burning in the case of these palms is almost unlimited if the central bud be not scorched.

An undescribed scale insect, belonging to the genus Leucaspis, has been found at the substation at Miami, Fla., attacking mangoes imported from India.

INSECTS INJURIOUS TO FORESTS AND FOREST PRODUCTS.

The mountain pine beetle (*Dendroctonus monticola* Hopk.) has attracted special attention this year because of its destructive habits. It has killed 90 per cent of the lodgepole pine and western yellow pine on an area of over 100,000 acres in the Imnaha National Forest, of northeastern Oregon, about 35 per cent of the timber over large areas in the Weiser National Forest, of western Idaho, was quite destructive to western white pine in Washington and Montana, and continued its depredations in the Yosemite National Park in California.

The Black Hills beetle (*Dendroctonus ponderosæ* Hopk.) continued its depredations in the Black Hills National Forest of South Dakota, and was quite destructive to lodgepole pine in the Uinta National Forest in northern Utah, and to western yellow pine in the National Forests of southern Utah, northern Arizona, and Colorado.

The roundheaded pine beetle (*Dendroctonus* n. sp.) has been found moderately destructive to the western yellow pine in the Lincoln and Sacramento National Forests of southern New Mexico, and has caused some damage in the Santa Catalina and Chiricahua National Forests of southeastern Arizona.

The Douglas spruce beetle (*Dendroctonus pseudotsugæ* Hopk.) continued a destructive enemy of the Douglas spruce in eastern Idaho, Utah, Colorado, and New Mexico.

The destructive pine beetle (*Dendroctonus frontalis* Zimm.) was reported as injurious from Virginia, North Carolina, South Carolina, Georgia, Mississippi, and Arkansas.

The white pine weevil (*Pissodes strobi* Peck) continued an important enemy of the white pine reproduction, and has also been noted as injurious to the Norway spruce.

The locust borer (*Cyllene robiniæ* Forst.) continues to be the most important insect enemy of the black locust.

Powder-post beetles (*Lyctus* spp., and *Sinoxylon* spp.) continue to cause serious injury to seasoned hardwood products.

A white grub (*Lachnosterna* sp.) was reported as very injurious to young white pine and young Scotch pine in New York.

The larch sawfly (*Holcocneme* (*Nematus*) *erichsonii* Hartig) continued to be abundant and destructive in the upper peninsula of Michigan, and was reported as injurious from Maine.

The fir tussock moth (*Notolophus oslari* Barnes) was quite destructive to small California white fir in the Stanislaus National Forest in eastern California.

INSECTS INJURIOUS TO THE PECAN.

The pecan budworm (*Proteopteryx deludana* Clem.) was injurious in Florida to the pecan, as also in North Carolina, and became very abundant in the District of Columbia late in the season.

The pecan webworm (*Hyphantria textor* Harr.) was quite destructive in the South, especially in South Carolina, Georgia, Florida, and Louisiana.

The pecan husk-worm (*Enarmonia caryana* Fitch) was very destructive to hickory nuts in Ohio and West Virginia and to pecan nuts in Louisiana.

The twig girdler (*Oncideres cingulata* Say) committed injury of quite pronounced character to pecan from North Carolina to Florida, as also in Alabama, Louisiana, Arkansas, Tennessee, and Missouri, and to elm in Kansas. An instance is recorded where the beetle cut all the twigs from one pecan tree. Others report that it injures pecan badly by cutting off bearing limbs.

The black walnut caterpillar (*Datana integerrima* G. & R.) was unusually abundant and troublesome from the District of Columbia southward to Florida and Louisiana and westward to Illinois. In the North it affected walnuts and in the South pecans.

The prominent caterpillar (*Schizura concinna* S. & A.) was quite abundant and locally injurious during the year on foliage of pecan in Florida and Louisiana.

The phylloxeras (*Phylloxera notabilis* Perg. and *P. globosus* Shim.) were the subject of complaint on the part of pecan growers in Mississippi and Texas.

The pecan leaf-miner (*Coleophora caryæfoliella* Clem.) was observed to attack the pecan in Florida.

The walnut sphinx (*Cressonia juglandis* S. & A.) came under observation as a pecan pest during September and October in Florida.

A weevil (*Conotrachelus elegans* Say) was reported attacking pecans in Texas and was observed doing considèrable injury to the roots of ornamental amaranth in the District of Columbia.

In addition to the species which have been enumerated on pecan, about thirty other insects which have done no serious injury have been under observation during the year. Among the most important are an unidentified cossid borer, the handmaid moth (*Datana ministra* Dru.); the May beetles *Lachnosterna submucida* Lec., *L. pruinina* Lec., and *L. fusca* Fröhl., the bagworm (*Thyridopteryx ephemeræformis* Haw.), and a caterpillar (*Tetralopha militella* Zell.).

INSECTS INJURIOUS TO SHADE TREES.

The brown-tail moth (*Euproctis chrysorrhœa* L.) has extended its range during the year but slightly, so far as reports go. The active work taken up by the States of Maine and New Hampshire has reduced its numbers, while in Massachusetts it is by no means so abundant as it has been in recent years.

The gipsy moth (*Porthetria dispar* L.) does not appear to have spread to the West, and the conditions in the interior of the infested region in Massachusetts have been greatly improved by the active work of the State of Massachusetts and the General Government. Hitherto-undiscovered colonies in Maine, however, have been found during the present year, but the occurrences in this State, so far as discovered, have by no means discouraged the State authorities in their attempt at extermination. The same may be said for southern New Hampshire.

The bagworm (*Thyridopteryx ephemeræformis* Haw.) was the most prominent shade-tree pest of the year, attracting very general attention from its northern limit in the vicinity of New York City, southward through New Jersey, Maryland, and Virginia, and westward through Pennsylvania, West Virginia, Ohio, Indiana, and Illinois, doing its chief injury in that region to arborvitæ and other evergreens, and various shade, forest, and orchard trees. Where observed its natural enemies were a very unimportant factor in its control, hence there is strong possibility of a recurrence of injuries in 1908.

The white-marked tussock moth (*Hemerocampa leucostigma* S. & A.) was abundant on shade and ornamental trees, as also on fruit trees, from Maine southward to Virginia and North Carolina and westward to Iowa and Kansas, but on the whole did little damage as compared with previous years, being almost completely controlled where observed, especially in Washington, D. C., by its numerous parasites.

The fall webworm (*Hyphantria cunea* Dru.) was comparatively rare, taking the country as a whole, colonies being localized and little positive injury being reported to this office. The insect came under occasional observation from Connecticut westward to Kentucky, and in Minnesota was described as a menace in the southwestern part of the State.

The catalpa sphinx (*Ceratomia catalpæ* Bdv.) the most important enemy of the catalpa, was unusually troublesome over a considerable area, including portions of Maryland, Virginia, District of Columbia, New Jersey, Ohio, Indiana, Kentucky, Georgia, and Florida.

The imported elm leaf-beetle (*Galerucella luteola* Müll), was not so abundant as usual but was generally troublesome in cities and towns in New England, New York, and New Jersey, and less so in Virginia. In the District of Columbia, as in previous years, its work was not noticeable. Injuries were reported in some new localities in Kentucky.

The larger elm leaf-beetle (*Monocesta coryli* Say) was abundant in Virginia, South Carolina, and Georgia, and caused considerable defoliation of elms.

The hickory tiger moth (*Halisidota caryæ* Harr.) was quite a troublesome pest during the year in portions of Ohio, Missouri, New Hampshire, and Vermont, injury being chiefly to the elm, although the rose was also attacked.

The green-striped maple worm (*Anisota rubicunda* Fab.) was reported defoliating the maple in Virginia and New York State.

Numerous complaints were made of injury by borers. Of these the common elm-tree borer (*Saperda tridentata* Ol.) continues to be a source of trouble from the havoc which it creates on elm trees, especially in large cities. In addition to Cincinnati, Ohio, where it has been a pest for many years, it has been reported from two new localities in that State—New Richmond and Lorain. It has also been abundant in Iola, Kans., and in Illinois. At Fairfield in the latter State the number of trees which are being killed is described as appalling. The bronze birch borer (*Agrilus anxius* Gory.) was reported a serious enemy to birch, especially white birch, and to Carolina poplar at Auburn, N. Y. The sugar-maple borer (*Plagionotus* [*Glycobius*] *speciosus* Say) was the cause of considerable complaint in New York, Pennsylvania, and Michigan. The imported willow curculio (*Cryptorhynchus lapathi* L.) was troublesome in Maine and was reported to be puncturing the young shoots of gardenias at Dorrancetown, Pa.

The year 1907 was preeminently an aphis year, and shade trees, as well as other forms of vegetation, suffered greatly from their presence. Prominent among these was the tulip-tree aphis (*Nectarophora liriodendri* Mon.) which was exceedingly abundant in the neighborhood of New York City and in the District of Columbia, in the latter locality causing the leaves to turn yellow and fall as early as July, when rain storms and natural enemies soon put a stop to further injury to this shade tree. Maples were also severely infested by aphides, *Drepanosiphum acerifoliæ* Thos. being a prevalent form.

Similarly scale insects of many species were unusually abundant on shade trees. The gloomy scale (*Chrysomphalus tenebricosus* Comst.) continues to in-

crease as a maple pest. The oyster-shell scale (*Lepidosaphes ulmi*) shows a similar increase in abundance and destructiveness, especially on maple, on horse-chestnut, and on some other trees. During the year it attracted special attention in Maryland and Pennsylvania. The terrapin scale (*Eulecanium nigrofasciatum* Perg.) was observed injuring maple in eastern Ohio and western Pennsylvania.

The cottony maple scale (*Pulvinaria innumerabilis* Rathv.) has been comparatively scarce for two years past, this scarcity being obviously due to the activity of its natural enemies.

Insects Injurious to Greenhouse and Other Ornamental Plants.

The rose-chafer (*Macrodactylus subspinosus* Fab.) was very troublesome on roses and other ornamental shrubs in Vermont, Pennsylvania, New Jersey, New York, Massachusetts, northern Ohio, and on Long Island.

Rose worms were moderately abundant. The American rose slug (*Endelomyia* [*Monostegia*] *rosæ* Harr.) was abundant in portions of Massachusetts and Ohio and remarkably common in the District of Columbia. The bristly rose worm (*Cladius pectinicornis* Fourc.) was moderately injurious to rose in the District of Columbia and in portions of Pennsylvania.

The fickle midge (*Sciara inconstans* Fitch) was reported injurious to begonia, vernonia, and fern in a greenhouse at National Military Home, Ohio, where it was impossible to control it. The wheat midge (*Sciara tritici* Coq.) was found attacking young tobacco plants in greenhouses in the District of Columbia. *Sciara vulgaris* Fitch was injurious to radish at San Francisco, Cal. Unidentified species of Sciara were under observation as enemies of beets and ornamental lily.

The greenhouse white fly (*Aleyrodes vaporariorum* Westw.) proved very destructive to a variety of ornamental plants grown in greenhouses in Wisconsin, Pennsylvania, and the District of Columbia. Tomatoes and cucumbers were similarly injured.

The rudbeckia aphis (*Nectarophora rudbeckiæ* Fitch) was very abundant in New York, Illinois, Vermont, Ohio, and the District of Columbia, affecting more particularly golden glow and chrysanthemum.

The yellow bear (*Diacrisia virginica* Fab.). There were many outbreaks of this species in various portions of the country, indicating general abundance. It was particularly troublesome on ornamental plants, including dahlia, chrysanthemum, hydrangea, calla, salvia, geranium, and coleus, from New York to the District of Columbia. In Maryland and Virginia it also attracted attention by its injuries to cabbage and lettuce. It was prevalent throughout July and August, but by September, in the District of Columbia, was observed to be dying of a fungous disease.

The salt-marsh caterpillar (*Estigmene acræa* Dru.) was the subject of many complaints, the insect being extremely abundant in Maryland, Virginia, and the District of Columbia on various truck and ornamental plants, the injury extending from New York to Kansas, Texas, and California.

Insects Injurious to Stored Products.

In recent years there has been a marked falling off in the number of complaints of losses by insects to stored grain and cereal products generally, which may be explained by the fact that millers, manufacturers, wholesale dealers, and others are well acquainted with the value of bisulphid of carbon and other insecticides used in fumigation. The extensive use of these and other remedies advised by the Bureau of Entomology has undoubtedly been the means of lessening the abundance of many insects of this class. A moderate number of complaints of such well-known insects as the granary and rice weevils, flour beetles, and meal-worms, the grain beetles, Indian-meal moth, and Angoumois grain moth have been received.

The Mediterranean flour moth (*Ephestia kuehniella* Zell.) continues to be a scourge in flour mills and has greatly increased its range, especially in the Eastern States, being reported from many new localities in the States of Vermont, North Dakota, West Virginia, Ohio, Michigan, Nebraska, Indiana, Texas, and Washington, as also in Canada.

The rice weevil (*Calandra oryza* L.) continues to do extensive injury to corn throughout the southwest. Ears often become infested in the field, thus increasing the injury after the corn has been stored. In many cases where the stored corn is not treated the loss is almost complete.

The European grain moth (*Tinea granella* L.) was observed attacking corn in the crib at Aurora, W. Va., and was found in the fruit of "jujube" imported from France.

The cigarette beetle (*Lasioderma serricorne* Fab.) was guilty of its customary injury to cigarettes, cigars, and tobacco, and to drugs, seeds, condiments, and furniture.

The dry fig beetle (*Carpophilus hemipterus* L.) was abundant in California. At Fresno it was the cause of much trouble and expense, due to its ravages in dried and drying figs. At San Francisco a shipment of garlic from New Zealand was found badly infested.

The ham beetle (*Necrobia rufipes* Fab.) caused considerable losses to stored meats at Richmond, Va.

The cheese maggot (*Piophila casei* L.). Complaints of injuries to hams and other stored meats by this species were received from Massachusetts and Virginia and from San Francisco, Cal.

Insects Injurious to Strawberry and Related Plants.

The strawberry crown girdler (*Otiorhynchus ovatus* L.) was reported injurious to crowns and roots of strawberries in Vermont, Utah, and Washington.

The strawberry weevil (*Anthonomus signatus* Say) was abundant in Maine, doing considerable damage to strawberry at Farmington. It was also injurious to blackberry and raspberry in Texas.

The strawberry leaf-beetle (*Typophorus canellus* Fab.) was reported to be doing very serious injury in strawberry beds at Bradford, Vt., and to raspberries at Santa Clara, Cal., work by the beetles only being noticed.

The strawberry flea-beetle (*Haltica ignita* Ill.) was a pest in Florida, attacking, besides strawberry, crape myrtle, roses, lilies, and grasses. The same species was reported common on wild rose in Maine.

The strawberry leaf-roller (*Ancylis comptana* Fröl.) was injurious to strawberry in Idaho, but did not attract attention in the East.

A blackberry stem-borer was injurious to Loganberry, blackberry, and raspberry in parts of Southern California.

The strawberry root-aphis (*Aphis forbesii* Weed) attracted attention in Illinois and in the Norfolk region of Virginia, in the latter district injury being estimated at $1,000.

Insects and Ticks as Animal Parasites and as Conveyors of Disease.

Owing to the character of the summer, mosquitoes were more abundant in many parts of the country than usual, and, while there was no outbreak of yellow fever, malaria was common in many regions. Following the original incentive of the Bureau of Entomology, much work was done against mosquitoes, and several cities made an effort to limit the supply of house flies. The screw-worm fly (*Chrysomyia macellaria* Fab.), the southern buffalo gnat (*Simulium pecuarum* Riley), and the horse-flies or gadflies were very abundant in the South.

The North American fever tick (*Margaropus annulatus* Say) was much more numerous in Texas and Louisiana than normal in the spring of 1907. This was due to an abnormally mild winter. Many hundreds of cattle perished from gross infestation. Later in the season unusually dry weather served to check the pest. The discovery was made that the cattle tick occasionally infests sheep.

The spinose ear tick (*Ornithódoros megnini* Dugès) has been found to occur in portions of three parishes in northern Louisiana. The infestation probably originated with the importation of horses from western Texas.

The tropical horse tick (*Dermacentor nitens* Neum.) was a serious pest in the vicinity of Brownsville, Tex. It infests ears of horses and causes great damage.

A tick (*Dermacentor venustus* Banks) has been found to transmit a disease of human beings extensively distributed through the northern Rocky Mountain States.

The fowl tick (*Argas miniatus* Koch) has made profitable poultry raising almost impossible in some parts of southwestern Texas.

The ox warble (*Hypoderma lineata* Villers) was slightly more numerous than in 1906.

The horn fly (*Hæmatobia serrata* R.-D.) was exceedingly numerous in the spring in Texas and Louisiana. The dry weather gave it a material check, but it became numerous again in localities where rain falls during the summer.

PROGRESS IN FOOD AND DRUG INSPECTION AND LEGISLATION.

By W. D. Bigelow, *Assistant Chief, Bureau of Chemistry.*

ENFORCEMENT OF FEDERAL FOOD AND DRUGS ACT.

The establishment of an adequate organization for the enforcement of the food and drugs act has constituted an important part of the work of food control during the past year. The six branch laboratories of the Bureau of Chemistry, previously maintained for the examination of imported foods, have been greatly enlarged, and additional laboratories have been established at St. Paul, Buffalo, Detroit, Kansas City, Mo., Denver, Galveston, Portland, Oreg., Savannah, Seattle, and Cincinnati. This increase has necessitated altering and enlarging the methods of work heretofore followed. The increase in the number of laboratories has made it possible to effectually enforce the law relative to imported foods and drugs at almost all the leading ports of entry and distribution, and arrangements have been made also at the remaining ports whereby the inspection of imported foods and drugs may be made practically complete.

A force of inspectors has been appointed who work under the direction of a chief inspector and secure samples of foods and drugs on sale in different sections of the United States, as well as information regarding the methods of manufacture and commercial methods and secure information regarding possible violations of the law in connection with the manufacture and sale of foods and drugs.

It was impossible to secure a sufficient number of inspectors or chemists possessing the requisite training and experience in foods and drugs, and considerable time was consumed in giving the necessary training to the men employed. The inspectors reached their respective stations during the latter part of June, 1907, and at once proceeded to secure samples of foods and drugs. During the remainder of the year 7,041 samples of foods and drugs were sent to the laboratories for examination. Although the analysis of all these samples has not been completed, 323 hearings have been conducted and 12 criminal cases have been transmitted to the Department of Justice for prosecution. In addition to the criminal cases brought for the violation of the law 20 lots of goods have been seized because of having been shipped in interstate commerce in violation of the law, and confiscation proceedings in libel have been instituted regarding them.

EXPERIMENTAL WORK WITH PRESERVATIVES.

Methods of manufacture have been studied with a view to determining whether they were in conformity with the law; and, wherever possible, assistance has been given manufacturers in improving these methods. The experiments in the preservation of apple cider by means of pasteurization, reported in the Yearbook for 1906, have been extended, and Mr. H. C. Gore has succeeded without difficulty in preserving cider in larger receptacles, 5-gallon cans, 10-gallon kegs, and barrels being employed for this purpose. This work has also been undertaken on a large scale by manufacturers, and large quantities of unfermented grape juice have been preserved by sterilization in barrels.

The Department, in cooperation with manufacturers of tomato catsup, has preserved that product on a commercial scale by means of sterilization and without the use of chemical preservatives. The same studies have been extended to the preservation of pie-filling and other articles of commerce in the manufacture of which preservatives are commonly used. The preservation of sweet pickles and mince-meat without the use of chemical preservatives also appears to have been satisfactorily accomplished by manufacturers, but has not been undertaken by the Department.

A systematic study has also been made of the use of sulphur in drying fruit in various sections of the United States and in the manufacture of sirup and molasses. The Department has ascertained by practical experiments, in collaboration with the dryers and packers, the amount of sulphur introduced into the fruit by the methods ordinarily employed, as well as by modifications of those methods. The fruit investigated included apples in New York State, and peaches, pears, ruby and silver prunes, raisins, and apples in California.

The fruit prepared under the observation of the Department's representatives was taken to the packing house, where it was subjected to the processes ordinarily employed by the packer and modifications of the same, after which

samples were taken for analysis. Additional quantities of fruit so prepared were shipped to Washington for the purpose of ascertaining the influence of shipment to which it is exposed under commercial conditions. Samples were again examined and are being held and examined at intervals to determine the influence of storage on the sulphur content. It was found that, when evaporators were to be employed, the use of sulphur with stone fruits could be advantageously replaced by steaming for from 10 to 15 minutes. The color of the fruit so dried was uniform and satisfactory and the fruit softened by steaming dried as readily as that softened by the fumes of burning sulphur. By dipping the peeled and cored apples into a weak solution of common salt, the darkening that ordinarily attends their drying was entirely avoided and a product of excellent appearance produced.

Under the direction of the Department molasses and sirup were prepared without the use of sulphur. Samples of molasses and sirup from the sugar exchange in New Orleans were also examined and the results showed that the amount of sulphur supposed to be introduced into such products during their manufacture had been greatly exaggerated. Only in exceptional cases were samples found to contain 350 milligrams per kilogram. Considering this, and also the fact that the sulphurous acid content of molasses and sirup decreases on standing, and would therefore necessarily be less in the products found in commerce than in the samples first submitted for sale by the manufacturer, it would appear that the excessive amounts of sulphurous acid that have been frequently reported in sirups and molasses on sale in the retail market are due to the manipulation subsequent to their sale by the original manufacturer.

In connection with the enforcement of the food and drugs act many questions submitted by manufacturers and dealers have been considered by the Department and Food Inspection Decisions have been issued from time to time, expressing the opinion of the Department regarding the various questions involved. Many questions regarding which investigations have been made are at present under consideration by the Department and decisions will be announced at a later date.

The studies regarding the influence of chemical preservatives on nutrition and health have been continued and the reports on sulphurous acid and benzoic acid have been completed, the former having been published and the latter being in the hands of the printer.

COLD-STORAGE INVESTIGATIONS.

The study of the influence of cold storage upon the nutritive value and wholesomeness of food has been continued. Evidence is being secured that will be of value in limiting the time during which food products can properly be stored in this manner. It has been demonstrated that there is considerable abuse connected with the storage of fowls and game as commonly practiced, the time during which these products are stored often being excessive. It has been demonstrated that after a long period of storage the connective tissue is largely destroyed and the nature of the product greatly altered.

The influence of cold-storage preservation on eggs has also been carefully studied. Considering the important position of eggs in the list of foods commonly used for the sick, the sale of stale eggs as fresh has always been regarded as most reprehensible. This practice has largely increased during recent years, owing to the growing tendency to preserve eggs in storage, and facilities for such preservation have been multiplied. As a result there have been commonly found upon the market, during recent years, eggs which were not entirely fresh, although the changes therein were so slight that their detection was a matter of some difficulty. In the study of this subject, conducted by the Bureau of Chemistry, the changes occurring under storage conditions have been carefully considered and marked progress has been made in methods of detecting eggs preserved in this manner.

MISCELLANEOUS INVESTIGATIONS.

In the Bureau of Chemistry in Washington and also in the branch laboratories investigations are in progress regarding the methods of manufacture and preservation of foods and drugs and methods for the detection of improperly prepared or adulterated products. Among the more important studies of this nature now in progress may be mentioned the bleached flour investigation which is being conducted in the Bureau of Chemistry in Washington and in the branch laboratories at Chicago and St. Paul; the lemon oil investiga-

tion which is being conducted in the Bureau of Chemistry in Washington, in the branch laboratory at New York, and by a representative of the Bureau in Sicily; the whisky investigation, conducted mainly in the Bureau of Chemistry in Washington; and the investigation of nonfermented beverages or soda-water sirups alleged to contain cocaine or other objectionable drugs.

In addition to this much progress has been made during the last year in the perfection of methods for the examination of foods and drugs, and investigations looking to the further improvement of these methods are still in progress.

STATE LEGISLATION.

The effect of the passage of the Federal food and drugs act of June 30, 1906, on State legislation during the year 1907 was strikingly shown, the year being marked by the most unusual activity in the enactment of laws regulating the manufacture and sale of foods. During that time 44 legislatures were in session and 40 enacted laws relating to the purity of foods. Of the 4 remaining legislatures (those of Arizona, Georgia, New Mexico, and Rhode Island) 2 represent Territories, which come under the Federal food and drugs act. Just before the adjournment of the Georgia legislature in 1906 a pure-food law was passed, framed after the Federal law, which doubtless explains the absence of legislation on this subject during the year 1907. A pure-food bill was also before the Rhode Island legislature, but failed to be recommended from the committee on the ground that in the form presented it might conflict with the Federal regulations. It was thought best, owing to lateness in the session, to wait another year and frame a bill which would coincide with the National law. From this it will be seen that practically all of the States in which legislatures were in session after the enactment of the Federal law gave their attention to a greater or less extent to the subject of food adulteration. Comprehensive food laws were not enacted by all of the 40 legislatures, but in all cases laws looking to the betterment of the food now on the market were passed, thus indicating that the whole country realizes the importance of this question, and is giving its support to the enactment of laws which will eventually correct the evils that have so long existed.

Seven States and the Philippine Islands, which had previously made no attempt whatever to control the character or purity of their foods, enacted new laws, creating the necessary offices and making appropriations to make the enforcement of laws possible. New laws were also enacted in 3 States which will probably not be enforced because of the failure to provide either enforcing officer or appropriation. Of the States which previously enforced food legislation, 21 during the last year have enacted new laws or amended existing laws in a way to bring them more into conformity with the general principles of the Federal food and drugs act.

The tendency in this direction at the present time is well illustrated by a comparison of the number of States now enforcing food laws with the number that enforced them in 1905. Of the 53 States and Territories in the United States, including the insular possessions, 25 made a serious attempt to enforce creditable food laws in 1905 as compared with 42 at the present time. These numbers do not include the States in which laws have been enacted without appropriations for their enforcement. Of the remaining number, 3 are Territories and come within the provisions of the Federal food and drugs act. Only 8 States, therefore, have no food laws with appropriations and machinery for their enforcement. In a number of cases these appropriations are not adequate, but they permit a beginning and the comparison with the condition that obtained two years ago is very favorable.

In almost all cases the laws have been brief and concise, depending on the enforcing officer to establish regulations for their enforcement or adopting the regulations of the Federal act. Where standards are mentioned they are also with very few exceptions referred to the enforcing officer or it is provided that the standards of the United States Department of Agriculture shall be adopted. Almost without exception the new laws exempt the dealer from prosecution if he is provided with a guaranty from the person from whom he purchases the goods within his own State, and in several cases the guaranty is made to hold even if the guarantor resides anywhere in the United States. In many cases it is provided that the dealer or manufacturer shall be given a hearing by the enforcing officer previous to prosecution.

There appears to be a tendency to restrict the use of colors and preservatives to a greater extent than has been the case heretofore, and in almost all of the new laws the addition to foods of certain habit-forming drugs is prohibited.

In several States the salary of the enforcing officer or the chemist was increased and in other cases the appropriation for the organization charged with the enforcement of the State laws was largely increased. This can result only in good, as one of the great obstacles in the way of proper enforcement of food laws has been the limited compensation of those engaged in such enforcement and the small appropriation at their disposal.

Much attention was given to the subject of dairy products, and, if the number of States legislating on this subject can be taken as an indication, it would seem that his subject is second only in importance to that of foods in general. Many of the laws enacted prescribed standards of purity for milk and cream, or amended existing standards to bring them more in conformity with the standards of the United States Department of Agriculture; several provided that clean utensils be used for the handling of dairy products; others specified that cans used for the transportation of dairy products be branded in a special manner; and still others provided for the inspection of these products. In several cases the measures to be employed in testing milk and cream were also specified.

It was apparently realized that the practice of selling goods falsely branded as to weight or volume is quite prevalent, and in several instances laws were enacted looking to the correction of this evil.

Laws providing for the more rigid inspection of foods were also enacted. Especially is this true in the case of meat and perishable products where it is specified in a number of cases that diseased products shall not be offered for sale. In Kansas the sale of undrawn poultry is a misdemeanor. In quite a number of States laws were enacted prohibiting the use of contaminated waters for domestic purposes, and making provisions for the purification of the water supply.

AREAS SURVEYED AND MAPPED BY THE BUREAU OF SOILS.

By A. G. RICE, *Chief Clerk, Bureau of Soils.*

The following statement shows the location and extent of soil surveys made up to December 31, 1907. The Bureau prepares and issues a lithograph map, drawn on a scale of 1 mile to the inch, for each area surveyed, indicating in colors the distribution of the various soil types. The accompanying sketch map (fig. 56) gives the locations of these areas.

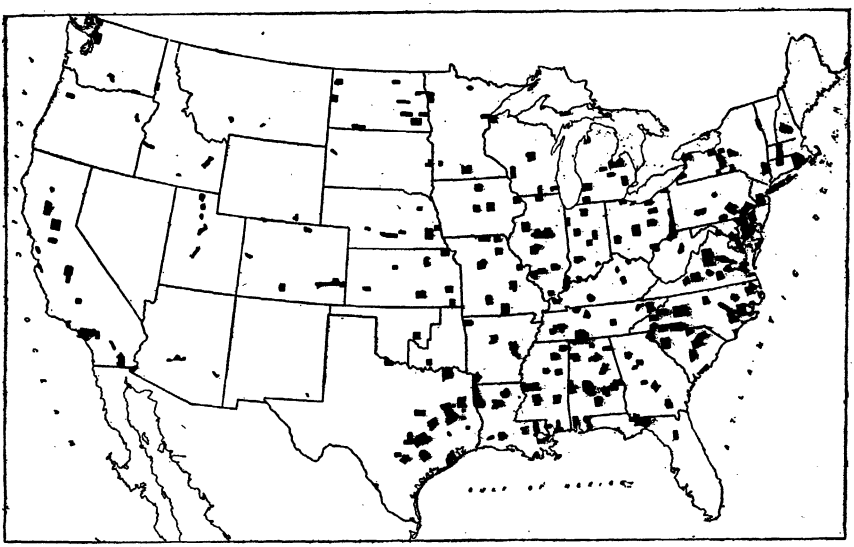


FIG. 56.—Location of areas surveyed and mapped by the Bureau of Soils.

The statement gives a list of the areas surveyed with the number of square miles in each, and the total area surveyed in each State and Territory. The total for the United States is 147,107 square miles, or 94,148,480 acres.

Areas of soil surveys in the United States to December 31, 1907.

	Square miles.	
Alabama:		
Blount County	625	
Butler County	771	
Dallas County	992	
Fort Payne area	509	
Huntsville area	506	
Louderdale County	708	
Lee County	629	
Macon County	621	
Marion County	739	
Mobile area	461	
Montgomery County	780	
Perry County	762	
Sumter County	893	
Talladega County	750	
		9, 746
Arizona:		
Salt River Valley area	449	
Solomonsville area	108	
Yuma area	340	
		897
Arkansas:		
Conway County	575	
Fayetteville area	569	
Miller County	626	
Prairie County	656	
Stuttgart area	251	
		2, 677
California:		
Bakersfield area	195	
Colusa area	756	
Fresno area	628	
Hanford area	216	
Imperial area	1, 084	
Indio area	234	
Los Angeles area	570	
Redding area	200	
Sacramento area	924	
Salinas Valley area	344	
San Bernardino area	755	
San Gabriel area	259	
San Jose area	313	
Santa Ana area	275	
Stockton area	521	
Ventura area	240	
		7, 514
Colorado:		
Arkansas Valley area	945	
Grand Junction area	168	
Greeley area	687	
San Luis area	628	
		2, 428
Connecticut:		
Connecticut Valley		505
Delaware:		
Dover area		314
Florida:		
Escambia County	662	
Gadsden County	548	
Gainesville area	485	
Jefferson County	585	
Leon County	675	
		2, 955
Georgia:		
Bainbridge area	364	
Cobb County	346	
Covington area	225	
Dodge County	489	
Fort Valley area	186	
Spalding County	205	
Waycross area	609	
		2, 424
Idaho:		
Boise area	399	
Blackfoot area	428	
Lewiston area	308	
Minidoka area	146	
		1, 281
Illinois:		
Clay County	460	
Clinton County	491	
Johnson County	339	
Knox County	717	
McLean County	1, 159	
Illinois—Continued.		
O'Fallon area	68	
Sangamon County	866	
St. Clair County	650	
Tazewell County	645	
Winnebago County	526	
		5, 921
Indiana:		
Boonville area	264	
Greene County	535	
Madison County	435	
Marion County	389	
Marshall County	445	
Newton County	393	
Posey County	387	
Scott County	197	
Tippecanoe County	499	
		3, 544
Iowa:		
Cerro Gordo County	567	
Dubuque area	440	
Story County	576	
Tama County	720	
		2, 303
Kansas:		
Allen County	504	
Brown County	573	
Garden City area	335	
Parsons area	398	
Riley County	634	
Russell area	270	
Wichita area	465	
		3, 179
Kentucky:		
McCracken County	242	
Madison County	437	
Mason County	225	
Scott County	280	
Union County	361	
Warren County	533	
		2, 078
Louisiana:		
Acadia Parish	636	
Caddo Parish	898	
De Soto Parish	825	
East Baton Rouge Parish	451	
Lake Charles area	202	
New Orleans area	410	
Ouachita Parish	605	
Tangipahoa Parish	788	
Winn Parish	950	
		5, 765
Maryland:		
Calvert County	217	
Cecil County	376	
Easton area	966	
Harford County	418	
Kent County	293	
Prince George County	480	
St. Mary County	363	
Worcester County	463	
		3, 576
Massachusetts:		
Connecticut Valley		809
Michigan:		
Allegan County	828	
Alma area	282	
Cass County	500	
Munising area	407	
Oxford area	210	
Owosso area	270	
Pontiac area	307	
Saginaw area	984	
		3, 788
Minnesota:		
Blue Earth County	749	
Carlton area	413	
Crookston area	779	
Marshall area	233	
		2, 174

Areas of soil surveys in the United States to December 31, 1907—Continued.

	Square miles.	
Mississippi:		
Biloxi area	615	
Crystalsprings area	231	
Jackson area	737	
Jasper County	675	
McNeill area	198	
Montgomery County	405	
Oktibbeha County	446	
Pontotoc County	405	
Prentiss County	415	
Smedes area	463	
Yazoo area	656	
		5,246
Missouri:		
Crawford County	747	
Howell County	919	
O'Fallon area	552	
Putnam County	523	
Saline County	748	
Scotland County	440	
Shelby County	511	
Webster County	605	
		5,045
Montana:		
Billings area	107	
Gallatin Valley area	325	
		432
Nebraska:		
Grand Island area	446	
Kearney area	792	
Lancaster County	857	
North Platte area	470	
Sarpy County	227	
Stanton area	323	
		3,115
New Hampshire:		
Merrimack County		923
New Jersey:		
Salem area	493	
Trenton area	810	
		1,303
New Mexico:		
Pecos Valley area		129
New York:		
Auburn area	461	
Bigflats area	223	
Binghamton area	229	
Dutchess County	800	
Long Island area	845	
Lyons area	515	
Madison County	649	
Niagara County	547	
Syracuse area	416	
Tompkins County	493	
Vergennes area	160	
Westfield area	260	
		5,598
North Carolina:		
Alamance County	365	
Asheville area	497	
Cary area	63	
Chowan County	178	
Craven area	897	
Duplin County	824	
Edgecombe County	515	
Henderson County	366	
Hickory area	988	
Mount Mitchell area	497	
New Hanover County	192	
Parmele area	236	
Perquimans and Pasquotank counties	461	
Raleigh to Newbern area	765	
Statesville area	784	
Transylvania County	372	
		8,000
North Dakota:		
Cando area	283	
Carrington area	720	
Fargo area	406	
Grand Forks area	314	
Jamestown area	496	
McKenzie area	348	
Morton area	544	
North Dakota—Continued.		
Ransom County	856	
Williston area	585	
		4,552
Ohio:		
Ashtabula area	340	
Cleveland area	509	
Columbus area	472	
Coshocton area	551	
Meigs County	443	
Montgomery County	480	
Toledo area	403	
Westerville area	476	
Wooster area	469	
		4,143
Oklahoma:		
Oklahoma County	720	
Tishomingo area	443	
		1,163
Oregon:		
Baker City area	158	
Salem area	284	
		442
Pennsylvania:		
Adams County	534	
Chester County	760	
Johnstown area	714	
Lancaster area	269	
Lebanon area	669	
Lockhaven area	278	
Montgomery County	496	
		3,720
Porto Rico:		
Arecibo to Ponce		330
Rhode Island:		
State		1,085
South Carolina:		
Abbeville area	1,006	
Campobello area	515	
Charleston area	352	
Cherokee County	361	
Darlington area	599	
Lancaster County	486	
Lee County	419	
Oconee County	652	
Orangeburg area	709	
Sumter County	586	
York County	669	
		6,354
South Dakota:		
Bellefourche area	190	
Brookings area	484	
		674
Tennessee:		
Clarksville area	547	
Davidson County	501	
Giles County	506	
Grainger County	307	
Greeneville area	664	
Henderson County	499	
Lawrence County	618	
Madison County	561	
Pikeville area	440	
		4,643
Texas:		
Anderson County	1,069	
Austin area	705	
Bastrop County	917	
Brazoria area	845	
Brownsville area	189	
Cooper area	625	
Henderson area	581	
Houston County	1,192	
Jacksonville area	100	
Lavaca County	995	
Laredo area	155	
Lee County	666	
Lufkin area	99	
Nacogdoches area	97	
Paris area	548	
Robertson County	852	
San Antonio area	484	
San Marcos area	515	
Vernon area	277	
Waco area	495	

Areas of soil surveys in the United States to December 31, 1907—Continued.

	Square miles.	
Texas—Continued.		
Willis area	215	
Wilson County	783	
Woodville area	100	
		12, 504
Utah:		
Bear River Valley	334	
Provo area	373	
Salt Lake Valley area	249	
Sevier Valley	235	
Weber County	310	
		1, 501
Vermont:		
Vergennes area		227
Virginia:		
Albemarle area	1, 410	
Appomattox County	340	
Bedford area	632	
Chesterfield County	478	
Hanover County	475	
Leesburg area	419	
Louisa County	505	
Montgomery County	392	
Norfolk area	303	
Prince Edward County	430	
Yorktown area	598	
		5, 982
Washington:		
Island County	233	
Everett area	525	
Walla Walla area	201	
Whatcom area	384	
Yakima area	309	
		1, 652
West Virginia:		
Upshur County	330	
Middlebourne area	952	
Wheeling area	315	
		1, 597
Wisconsin:		
Janesville area	451	
Portage County	797	
Racine County	326	
Superior area	482	
Viroqua area	504	
		2, 560
Wyoming:		
Laramie area		309
Total		147, 107

IMPROVEMENTS IN FARM PRACTICE.

By W. J. Spillman, *Agriculturist in Charge of Farm Management Investigations, Bureau of Plant Industry.*

At no time in the history of our country has there been greater interest on the part of farmers in improved methods than during the past few years. More effective means of bringing the results of scientific investigation to the farmers have been worked out, and more agencies have been employed than formerly in bringing this about. As a result, farmers generally are beginning to appreciate the value of science to their industry. This is especially true in the cotton fields of the South, where there is an increasing tendency toward deeper plowing and better methods of conserving or increasing the humus in the soil. The use of winter cover crops to prevent soil washing and to provide humus, while not at all general in the cotton belt, is met with much more frequently than it was a few years ago. In a few instances farmers who have sown bur clover in cotton just after the first picking and plowed it under before planting cotton again in the spring have greatly increased the yield. Where this practice has been in vogue for three years the yield has been raised from a third of a bale to a bale per acre. There is also an increased number of farmers who are growing cotton in rotation with grain and forage crops.

The production of hay in the South has been greatly stimulated during the past year by the publication of a bulletin from this Department giving a description of the methods and results obtained on a one-horse hay farm in South Carolina. One of the most marked defects of southern agriculture is the fact that insufficient hay is grown to supply local demands. Present interest in the subject indicates that within a few years the South will become independent of the North in this particular.

The type of live-stock farming which is gaining ground most rapidly in the South is hog raising. It is possible in that section to provide green pasture at all periods of the year. Hogs raised on such pasture, with a little grain, produce meat very cheaply, and interest in this type of farming is being manifested quite generally in the South. It is believed that the success of this kind of farming on the diversification farm at Uniontown, Ala., has done much to convince cotton growers that hog raising may be made profitable.

During the past few years there has been a renewal of the migration to the Plains region which has occurred periodically for nearly half a century. This migration has been due to three causes: First, the exhaustion of the supply of public lands; second, a temporary increase in rainfall in the region; third, an advertisement of methods of so-called dry farming. The impression prevails quite generally that new methods of farming have been developed for the dry regions which render agriculture much more reliable than it formerly was in

the Plains country. Important investigations are now in progress in that region, especially by the office of Dry-Land Agriculture Investigations of the Bureau of Plant Industry and by the local experiment stations, which it is believed will in time determine the value of various methods of handling the soil.

Interest in the alfalfa crop in the eastern half of the United States has waned to a considerable extent during the past year because of the repeated failure of those who have tried to establish this crop on their farms. The present public interest in this crop is the third movement of the kind within a century. About 1833 and again about 1866 farmers very generally over the East experimented with this crop under the name of lucern. It gained a permanent foothold at that time in only a few sections. The renewal of interest in this crop during the past ten years has resulted in its establishment in many more localities. The work of Forage Crop Investigations, of this Bureau, has resulted in much better knowledge of the methods required for establishing alfalfa in sections where it has hitherto failed. Generally speaking, four conditions are necessary for success: (1) The land must be rich, or must be made rich if it is not already so; (2) it must be rendered alkaline in some manner, preferably by the application of some form of lime; (3) it must be well inoculated with the germs required by the alfalfa plant; (4) at least in northern sections the seed should be sown on well-prepared land in summer, certainly before the 1st of September. Farther south the time of seeding is later in the fall or in early spring. Of course there are localities where alfalfa can be grown without all these conditions and precautions.

There has been a marked falling off in the area of oats grown in many States in recent years. The only explanation apparent is that farmers are beginning to realize the unprofitableness of this crop. A spring grain which will take the place of oats in our farm economy and yield a profitable crop is greatly needed.

The use of commercial fertilizers is extending westward every year. The advance guard of fertilizer agents has now reached the eastern edge of the Plains region as far north as Kansas and is invading the corn belt at a rapid rate. This general extension of the use of commercial fertilizers is undoubtedly due, in part at least, to unscientific systems of farming which have not paid proper attention to conserving soil fertility. The use of commercial fertilizers is a severe tax on farming, but apparently can not be avoided except with some more or less intensive type of live-stock farming.

The increasing popularity of sheep on American farms, which has been marked for the past five or six years, received a check during the past year, the price of animals of this class having fallen considerably. Some of the most important problems needing investigation relate to the management of sheep. On account of the prevalence of various diseases of these animals many farmers have abandoned them as a source of income on the farm.

There is a continued increase of interest on the part of farmers in the literature of this Department and of the experiment stations and of the agricultural press generally due to a more general recognition of the value of this literature to the practical farmer.

BOUNTY LAWS IN FORCE IN THE UNITED STATES JULY 1, 1907.

By D. E. Lantz, *Assistant Biologist, Biological Survey.*

The following are the provisions of law in force in the several States and Territories authorizing the payment of rewards for the destruction of noxious animals:

Arizona.—Board of supervisors of counties shall pay the following bounties for the destruction of noxious animals: For lobos or timber wolves, $20 each; for mountain lions, pumas, and panthers, $20 each; for lynx or wildcat, $5 each; for coyotes, $1 each; for raccoons, 25 cents each. The supervisors may at their discretion offer a bounty of not exceeding 7 cents for each jack rabbit. [Chapter 49, 1907.]

Arkansas.—The county court may pay a bounty for the destruction of wolves, wildcats, or panthers, and may fix the amount of such bounty. [Kirby's Digest, 1904, chap. 161 (Laws 1885).]

California.—It shall be lawful for the board of supervisors of each county in its discretion to fix and determine the bounty, to be paid out of the county fund, for the destruction of each coyote, wildcat, fox, lynx, bear, and lion,

and to prescribe rules for making proof of such destruction and obtaining the bounty. [Genl. Laws (Henning), 1905, p. 32 (Stat., 1883, chap. 79).]

The board of county supervisors shall have power to provide for the destruction of gophers, squirrels, other animals, noxious weeds, and insects. [Genl. Laws (Henning), 1905, County Government, p. 202.]

COLORADO.—A State bounty of $1 each on coyotes, $2 each on wolves, and $3 each on mountain lions is provided. [Chap. 36, 1893.]

On petition of 50 freeholders the county commissioner of any county may levy a tax of not more than 4 mills of the assessed valuation of property to pay an additional bounty on coyotes, wolves, and panthers, the amount of the bounty to be fixed by the county commissioners, and the sum raised by such tax to be set apart as a special bounty fund. [Chap. 41, 1897.]

For the past few years no State bounty has been paid in Colorado, the legislature having failed to appropriate money for the purpose.

CONNECTICUT.—Any town may offer a bounty of not exceeding $5 for each wildcat, and not over $1 for each skunk, raccoon, weasel, or woodchuck killed within its limits. The bounty is to be paid out of surplus funds from dog licenses of the preceding year. [Genl. Stat., 1902 (Rev. Laws 1888, sec. 137).]

A State bounty of $1 each is paid for foxes killed within the State. Paid from special appropriation. [Chap. 75, 1901.]

IDAHO.—A bounty of $15 each is paid for destroying cougars, lions, or panthers. Payment is made from current county expense fund. [House bill 182, 1905.]

The legislature of 1905 repealed the act of 1901 providing a bounty for killing coyotes, lynxes, and wildcats.

The legislature of 1907 enacted a law authorizing the counties to pay claims for bounty under the act of 1901, which had been filed prior to the repeal of the law and had not been paid for lack of funds. [House bill 215, 1907.]

The legislature of 1907 also amended the law creating the State sanitary board by authorizing said board to employ hunters and trappers to destroy predatory animals at a per diem compensation, and creating a "predatory animal fund" to pay the expenses by levying a special tax of 4 mills upon sheep and one-half mill on other live stock in the State. [House bill 97, 1907.]

The board of county commissioners of any county in the State, on petition of 100 or more taxpayers, may levy a tax of not exceeding 5 mills on the dollar of valuation for the purpose of exterminating crickets, grasshoppers, rodents, and rabbits, such tax to form a "pest fund." The actual work of extermination is placed in the hands of three persons to be appointed by the commissioners. [House bill 25, 1907.]

The State game warden is authorized to put into operation such methods and means as will best secure the extermination of wolves, coyotes, lynxes, cougars, and other predatory wild animals, and an appropriation of $5,000 was made for the purpose. [House bill 203, 1907.]

ILLINOIS.—The county board may offer such a bounty on wolf scalps as they may deem reasonable, the same to be paid out of the treasury of the county in which such wolf or wolves were killed. [Rev. Stat. (Hurd), 1897, chap. 148a (Laws 1877).]

A bounty of 25 cents each on woodchucks, or groundhogs, is paid by counties (or townships), when scalps are presented in lots of not less than four. [House bill 784, 1907.]

A bounty of 10 cents each on crows and 5 cents each on crows' eggs is paid by counties (or townships), when presented in lots of not less than ten. [House bill 115, 1907.]

INDIANA.—The commissioners of each county may cause to be paid out of the county treasury not exceeding $20 for a wolf and not over $5 for a fox killed within the county, provided that not over $3 be paid for a wolf under six months old or $1.50 for a fox under six months old. [Ind. Stat. (Horner), 1901, sec. 5783.]

The commissioners of each county may cause to be paid a bounty of not over $2 for each woodchuck, owl, or hawk—sparrow hawk and screech owl excepted. [Ind. Stat. (Horner), 1901, sec. 5783a.]

IOWA.—The board of supervisors of counties shall determine how much bounty, in addition to that already provided by law, may be paid from the county treasury for the destruction of wild animals, provided the bounty shall not be over $5 for each animal. [Code, 1897, sec. 422.]

Counties shall pay a bounty of $5 for killing an adult wolf, $2 for a cub wolf, and $1 for a lynx or wildcat. [Code, 1897, sec. 2348.]

A bounty of 10 cents each is paid by counties for the destruction of pocket gophers. The bounty must be claimed within thirty days after killing the gopher. [Chap. 121, 1907.]

KANSAS.—Counties shall pay the following bounties: For each coyote, $1; for each lobo wolf, $5; for each gopher, 10 cents. The law is to be in force from April 1, 1907, and payment of the bounty is obligatory. All laws in conflict are repealed. [Chap. 67, 1907.]

Boards of county commissioners may pay a bounty of not over 5 cents each for the destruction of crows. [Chap. 74, 1905.]

Chapter 378, Laws of 1903, providing for the destruction of prairie dogs, and chapter 324, Laws of 1905, providing for destruction of pocket gophers by townships are in force, but no bounty payments are involved.

MAINE.—A State bounty of $5 is paid for each wolf killed in the State. [Rev. Stat., 1903, chap. 32.]

A State bounty of $1 is paid for each seal killed in State waters. [Rev. Stat., 1903, chap. 41.]

A State bounty of $5 is paid for each bear killed in Oxford county. [Chap. 233, 1903.]

A State bounty of $5 is paid for each bear killed in Franklin County. [Chap. 160, 1905.]

MARYLAND.—The following are provisions of law applying to particular counties:

Calvert County.—A bounty of 50 cents each is paid on hawks and owls, small owls and fishhawks excepted. [Chap. 128, 1906.]

Charles County.—A bounty of 25 cents each is paid on hawks and owls, small owls and fishhawks excepted. [Chap. 511, 1906.]

Dorchester County.—A bounty of 25 cents each is paid on hawks and owls, screech owl and fishhawk excepted. [Chap. 381, 1906.]

Somerset County.—A bounty of 25 is paid on hawks, except fishhawk. [Chap. 323, 1906.]

St. Marys County.—A bounty of 5 cents each is paid on crows and 25 cents each on hen hawk and partridge hawk. [Chap. 753, 1906.]

MASSACHUSETTS.—Towns may appropriate money to encourage the destruction of noxious animals. [Chap. 38, 1838.]

Towns pay a bounty of $3 each on seals; the money is refunded to the town by the county. [Chap. 344, 1903.]

Towns pay a bounty of $5 each on lynx or wildcat; refunded by the county, [Chap. 246, 1903.]

MICHIGAN.—A bounty of 2 cents each is paid by the county for the destruction of English sparrows during the months of December, January, and February of each year. [No. 226, 1907.]

A bounty of $25 is paid by the county for the destruction of a wolf over three months old, and a bounty of $10 for a younger wolf. One-half the bounty is refunded to the county by the State. [No. 284, 1905.]

This law was amended by No. 255, Public Act of 1907, as to manner of proof and duty of clerks.

Boards of supervisors of counties shall have power to award further bounties for the destruction of wolves, panthers, and other noxious animals. [Comp. Laws, 1897, chap. 142 (added 1869).]

A bounty of $3 each is paid on wildcats and $5 each on lynxes. Payment and proof is the same as in the case of wolf bounty. [Comp. Laws, 1897, chap. 142 (added 1897).]

MINNESOTA.—County commissioners may by resolution offer and pay a bounty of 5 cents each for pocket gophers, 3 cents each for other kinds of gophers; 10 cents per dozen for blackbirds killed in April, May, or June, and 5 cents per dozen for blackbirds killed in July, August, September, or October; and 10 cents for each crow killed between May 15 and June 15 and between August 15 and September 15. The bounty shall be in force only for the year covered by the resolution, but may be renewed from year to year. [Revised Laws, 1905, sec. 2402.]

A State bounty of $7.50 each is paid for each grown wolf and $3 for each wolf cub destroyed. County commissioners may add to such reward and appropriate county funds therefor. [Laws, 1903, chap. 113 (as amended 1907).]

Chapter 113, laws of 1903, was recently amended as to methods of proof and style of certificate. [Chap. 298, 1907.]

The same law was amended by increasing the bounty on cub wolf from $1 to $3. [Chap. 381, 1907.]

MISSOURI.—The county court may offer a bounty of not exceeding $3 each for the destruction of wolves. Half the bounty is paid by the State. [Rev. Stat., 1899, chap. 175.]

MONTANA.—State bounty on grown wolf, $10; coyote, coyote pup, or wolf pup, $3; mountain lion, $10. A special State bounty fund is created by a tax of 4½ mills of assessed valuation on all live stock in the State. [Chap. 49, 1905.]

A law intended to prevent fraud in bounty payments was passed by the legislature of 1907. [Chap. 93, 1907.]

NEBRASKA.—On petition of 50 taxpayers, counties may vote on granting bounties for the destruction of wild animals. If the proposition is adopted, anyone killing a wolf shall receive a bounty of $3; a wildcat, $1; a coyote, $1. The bounty to be paid from the county general fund. [Chap. 162, 1879.]

A State bounty of $5 each on gray wolves, $1.25 each on coyotes, and $1 each on wild cats is paid, the payment being provided for by biennial State appropriations. [Chap. 4, 1905.]

NEVADA.—There is a county bounty of 50 cents each for coyote or wolf; $1 each for lynx, wildcat, or California lion, not less than 10 scalps to be presented at one time. The person claiming the bounty must pay fees of 25 cents each for oath and certificate. [Comp. Laws, 1900, sec. 5084 (laws 1887, chap. 38).]

There is a county bounty of 1½ cents each on pocket gophers, not less than 100 scalps to be presented at one time. Fees of 25 cents each for oath and certificate are to be paid by the person claiming the bounty. [Comp. Laws, 1900, sec. 5089 (laws 1891, chap. 37).]

NEW HAMPSHIRE.—A State bounty of $5 each is to be paid for bears killed in the State. [Chap. 118, 1901.]

There is a State bounty of $1 per bushel for grasshoppers destroyed in the State. [Chap. 118, 1901.]

NEW JERSEY.—A county bounty of $3 each is offered for foxes killed within the county. [Chap. 112, 1902.]

The law of 1902 was amended by adding the provision that it shall not apply to counties in which the freeholders by a two-thirds vote decide that the law is not for the best interests of the county. [Chap. 320, 1906.]

NEW MEXICO.—County bounties are paid as follows: On coyotes, wildcats, or lynxes, $1 each; on gray wolves, lobos, and bears, $20 each, and on mountain lions, $10 each. A fund for payment of bounties called the "wild animal bounty fund" is raised by a special tax of not exceeding 4 mills on value of all live stock of the Territory (tax higher for 1905 and 1906). [Chap. 77, 1905.]

NEW YORK.—A State bounty of $20 is paid for each panther killed. The bounty is paid by county and allowed by the State in settlement of taxes due from the county. [Genl. Laws, 1900, chap. 31, p. 2512.]

Boards of supervisors may make such laws and regulations as they may deem necessary for the destruction of wild and noxious animals and weeds within the county. [Genl. Laws, 1900, chap. 18, p. 1203.]

The State bounty on bears was repealed in 1895; that on wolves in 1898.

NORTH CAROLINA.—*Graham County.*—The county commissioners are authorized to pay a bounty of $5 each on wolves or panthers and $1 each on wildcats killed within the county. [Chap. 53, 1907.]

NORTH DAKOTA.—The county commissioners of each county shall offer a bounty of $2 for each wolf or coyote killed within the limits of the county. [Chap. 215, 1901.]

The board of county commissioners of any county within the State may offer a reward of not more than $20 nor less than $5 for the destruction of each buffalo or timber wolf, "killed within their respective counties." [Chap. 216, 1901.]

A State bounty of $2.50 each is paid on all wolves and coyotes. A special tax of two-tenths mill on all property creates a State wolf bounty fund from which payments are made. [Chap. 207, 1903.]

The county commissioners of any county may levy a tax of not exceeding one-half mill on the assessed valuation of all real estate, the proceeds to be used solely to promote the destruction of gophers and prairie dogs. On petition of not less than 35 per cent of the voters, the county commissioners may offer a bounty on prairie dogs and gophers. [Chap. 114, 1905.]

OHIO.—Townships pay a bounty of 10 cents each for the destruction of woodchucks. [Act of Mar. 13, 1888, amended Mar. 27, 1889.]

Townships pay a bounty of 20 cents per dozen for the destruction of English sparrows. [Act of Mar. 30, 1888, amended Apr. 11, 1890.]

OKLAHOMA.—County commissioners may at their discretion pay a bounty of $3 each for gray wolves and $1 each for coyotes, payment to be made from general county fund. [Rev. Stat., 1903, chap. 3, sec. 121.]

County commissioners may levy a tax of not to exceed 5 mills for the extermination of prairie dogs. [Chap. 27, 1905.]

OREGON.—The following bounties are paid from funds derived from fines and licenses and at the disposal of the State fish commissioner: For killing common seal, $1; for sea lion, $2.50; for sheldrake, shag, or cormorant, 5 cents each. [Genl. Laws 1901, Sen. bill 112.]

The county court of each county fixes the amount of bounty it will pay for the destruction of predatory animals. The court levies a tax of not less than one-tenth mill or more than 1 mill on property to provide funds for payment of bounties. The fund raised is not kept separate, and, if it is exhausted, payments are made from the general fund. [Chap. 213, 1907.]

PENNSYLVANIA.—A State bounty is paid as follows: On wildcat, $4; on fox, $2; on weasel or mink, $1. The appropriation to pay bounties for the biennial period 1907–8 is $50,000. [Act. 53, 1907.]

The former law of 1899, amending title to an act of 1897, providing for county payment of bounties on wildcats, foxes, and hawks, had been declared unconstitutional.

RHODE ISLAND.—A State bounty of $1 each is paid for killing foxes. [Chap. 968, 1902.]

A State bounty of 25 cents each is paid for killing wild hawk (except fish-hawk), wild crow, or wild owl. [Chap. 1160, 1904.]

The appropriation to pay bounties for 1907 was $750.

SOUTH DAKOTA.—County commissioners may offer a bounty of not less than 5 cents nor more than 10 cents each for the destruction of pocket gophers within the county. [Chap. 31, 1893.]

The State offers a bounty of $5 for killing grown buffalo, black, or gray wolf; $2 for pup wolf or coyote; and $3 for a mountain lion. An appropriation of $10,000 per year is made for payment of bounties. If the claims filed exceed the appropriation, pro rata payment must be accepted in full of claims for bounty. [Chap. 177, 1905.]

The county commissioners may offer a bounty of $3 for each and every wolf killed within the limits of the county. [Rev. Code, 1903, sec. 3122.]

TENNESSEE.—Any person killing wolves or panthers in the State, upon application to the county court with proper proofs, may receive a certificate from the court entitling him to a bounty of $2 for each animal, which certificate may be applied on the payment of State and county taxes not to exceed one-half the total tax of the person. [Rev. Code 1896, sec. 2875 (laws 1879, chap. 138; laws 1889, chap. 200).]

TEXAS.—A county bounty of 50 cents each is paid on coyote, wildcat, or catamount; $5 each on any other kind of wolf, Mexican lion, tiger, leopard, or panther. Certain counties are excepted. [Chap. 86, 1903.]

The general bounty act of 1903 was amended by excepting 171 counties (including those excepted in the original law) from its provisions. [Chap. 71, 1905.]

UTAH.—A State bounty of $2.50 each is paid on coyote, lynx, and wildcat, half to be paid from $10,000 general appropriation and half from the "fund for extermination of wild animals," which is derived from a special tax of 3 mills on the valuation of all sheep in the State. Counties may pay an additional bounty not to exceed half the State bounty. Requirements as to proof and penalties remain as in the law of 1905 (chap. 114). [Chap. 95, 1907.]

VERMONT.—All bounty laws were repealed in 1904. [No. 131, 1904.]

VIRGINIA.—The boards of supervisors of counties may at their discretion award a premium not exceeding $5 for each wolf scalp; $1.50 for each scalp of wildcat, catamount, or red fox; 75 cents for each scalp of gray fox; and 50 cents for each scalp of chicken hawk or owl, except screech owl. [Code, 1904, sec. 834.]

WASHINGTON.—A State bounty of $1 each on common seals, and $2.50 each on sea lions. Rewards are paid under the direction of the State fish commissioner and are limited to $2,500 per year. [Chap. 167, 1903.]

No appropriations were made for seal bounties 1905 or 1907.

The following bounties are paid from the general expense fund of each county: For each coyote or wolf, $1; for each lynx or wildcat, $2.50; and for each cougar, $5. The amounts paid are credited to the county by the State. [Chaps. 8 and 63, 1905.]

The bounty appropriation for biennial period 1907–8 is $25,000.

WEST VIRGINIA.—The county court of any county may offer reasonable bounties or rewards for the destruction of noxious animals, birds of prey, or weeds in the county, and provide for payment of such bounties out of the county treasury. [Code, sec. 1227 (laws 1881, chap. 5).]

WISCONSIN.—A county bounty is paid on mature wolf, $10; on wolf cub under 6 months old, $2; on wildcat or lynx, $3. The State makes equal payment to that by the county, thus doubling the bounty. [Chap. 324, 1905.]

WYOMING.—A State bounty is paid on coyotes, $1.25 each; on gray or black wolves, $5 each; on mountain lions, $5 each. Counties are permitted to offer additional bounties, not exceeding those paid by the State. Appropriation to pay State bounties for two years, $40,000. [Chap. 25, 1907.]

PROGRESS OF FORESTRY IN 1907.

By Q. R. CRAFT, *Forest Service.*

ADVANCE OF AMERICAN FORESTRY IN A DECADE.

In the last ten years forestry has advanced in this country from an almost unknown science to a useful, growing profession. In that time the number of technically trained foresters has increased from less than a dozen to over 400. Ten years ago there was not a single forest school in the country; now there are several professional forest schools which rank with those of Europe, and a score more with courses in elementary forestry whose usefulness is steadily growing. Forest lands under management have grown from one or two tracts to many, aggregating 7,503,000 acres, scattered through 39 States. The National Forests have increased from 39,000,000 acres, practically unused and unprotected, to 165,000,000 acres, used, guarded, and improved both in productiveness and accessibility. The number of States which have State forests has increased from 1 to 10; and of those which employ trained foresters from none to 11. The membership of forest associations has increased from 3,600 to 15,800. Ten years ago, except for a few of the foremost botanists, European foresters knew more about American forests than did the people of this country. In Europe they were then using preservatives to prolong the service of beech ties, and so adding from twenty to forty years to their life. Here, on the other hand, scarcely a treated tie had been laid, whereas there are now 60 treating plants, 27 of which treat ties exclusively, and an engineer who recently returned from Europe reports that both in size and mechanical perfection the treating equipment of this country is ahead of any to be found abroad.

And yet American forestry has only safely passed the experimental stage and got ready to do something. Action, immediate and vigorous, must be taken if the inevitable famine of wood supplies is to be lessened. We are now using as much wood in a single year as grows in three, with only twenty years' supply of virgin growth in sight. Only the application of forest knowledge with wisdom, method, and energy, in the next ten years, can prevent the starving of National industries for lack of wood.

TIMBER A PROFITABLE CROP.

The growing of timber as a farm crop has gained a permanent place in American agriculture. Each time a thrifty farmer sees a neighbor cutting a supply of fence posts and obtaining, out of the same stock, enough firewood to pay for the work, or selling on the stump a quantity of saw timber, the product of a farsighted investment of fifteen, twenty, or twenty-five years ago (Pl. LXIV), he realizes more keenly the importance of the wood crop. A farm without a good woodlot is incomplete.

Where the rainfall is heavy, the woodlot can be maintained on land not the best for other purposes, while, in a region where good land must be selected, it is the opinion of experienced men that the trees pay for the ground they occupy, in protection to the farmstead, the orchard, or adjoining fields. With the shelter of a windbreak, less feed is required to winter stock, danger to an orchard from late frosts is reduced, and the comfort of the home, as well as its beauty, is greatly increased. Indeed, some owners have estimated the value of good groves at $1,000 an acre, on the ground that the value of their property is increased to that extent by the trees. Where the forest has been given attention, the returns have yielded a net profit of $4,

$6, $8, and $10 per acre. The choice of species, methods of planting and care, suitability of the soil, and local market conditions may vary so widely that it is difficult to generalize for the country as a whole. However, in every State a share of the farm can be devoted to growing timber with a profit in some cases nearly or quite equal to that obtained from agricultural crops. In addition, protection, the convenience of having farm repair materials at hand, and increase of farm values are secured.

That forest planting is increasing is evident from the increased demand for planting material. One nurseryman last spring shipped 400,000 jack pine seedlings to Nebraska alone. One order, for 10,000, was for planting in the vicinity of the Brunner plantation, in Holt County, an example of successful forest planting which has been of high educational value. The Government nursery at Halsey has also been most helpful in determining the adaptability of conifers for planting on sandy soils in Nebraska and adjacent States.

Plans have been made for a Florida tract, which involve the most extensive replanting ever begun in the South. The lands, situated in Marion and Citrus counties, include 3,000 acres of sandy brush and grass-covered land, which it will be necessary to restock by artificial means. Longleaf pine seed will be sown in spots as a means of accomplishing this.

In New England, New York, and Pennsylvania great interest has been taken in planting white pine and other species, while eucalyptus planting has been given much attention in California. The interior of one of the largest buildings in Los Angeles was finished in eucalyptus imported from Australia at $250 a thousand board feet. This tree grows very rapidly, and is especially adapted to California. Four companies have been formed, which will plant in the aggregate several thousand acres with eucalyptus. It is with this tree that the Santa Fe Railway is planting 8,650 acres near San Diego, to test its suitability for the production of ties.

The woodlot offers an excellent opportunity for the practice of forestry. It is accessible enough to allow of moderate cuttings at frequent intervals, and it may be protected from trespass and grazing, and from fire, its chief enemy, without an elaborate scheme of defense; then, taxation is not a great burden, because the revenue from farm supplies more than meets this item every year and thus prevents the accumulation of interest.

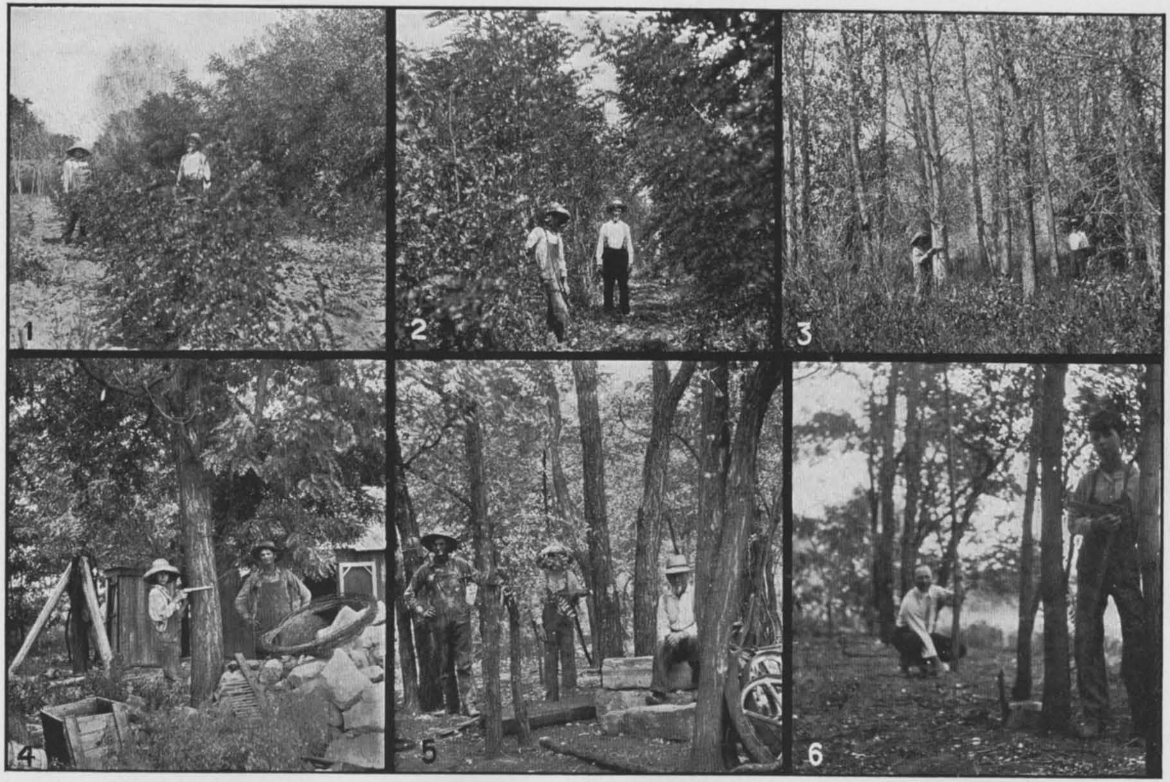
The application of intensive forestry to large tracts will naturally be of limited extent for some time to come. Closer utilization, provision for a second crop by the setting of a minimum diameter below which trees shall not be cut, and protection from fire are conservative measures which are steadily gaining ground. But looking into the future far enough to make provision for a third crop is not yet common, while efforts to bring forest lands to high productive capacity have as yet scarcely been attempted. In wealth of soil and high commercial value of native trees America has a decided advantage over Europe, where intensive forestry is paying well. American corporations and long-time investors, as well as the provident farmer, must go deeper into forestry to reap full reward.

An increased appreciation of the value of young forest is shown by the fact that in northeast Connecticut corporations are buying lands well stocked with trees 10 or 15 years old at prices which make it profitable to buy cut-over lands and restock them.

Experiments to learn what woods can be used to supplement the use of spruce for paper have shown conclusively that pulp of commercial value can be manufactured by the sulphite process from the hemlock of the Northeast and Lake States, Michigan tamarack, the loblolly and scrub pine of the South Atlantic and Gulf States, the cypress and tupelo gum of the southern swamps, the lodgepole pine and Engelmann spruce of the Rocky Mountain region, and the white fir and western hemlock of the Pacific coast. The experiments indicate that much of the pulp can be bleached and used for high-grade paper. White fir is especially suitable for the manufacture of papers where a long fiber and a good color of unbleached stock are desired.

California tanbark oak, hitherto considered of principal value for the tannin in its bark, has been found through timber tests to be suitable for cooperage and wagon manufacture. In strength it compares favorably with eastern oaks and hickory.

Recent tests on structural timbers—loblolly, longleaf, and Norway pines, and tamarack, for the eastern United States, and Douglas fir and western hemlock for the western—have shown longleaf pine to be the strongest and stiffest of the timbers mentioned, with Douglas fir a close second, while western hemlock, loblolly pine, tamarack, and Norway pine follow in the order given. Fortunately, Douglas fir and western hemlock, of which there are comparatively large supplies, have high structural merit, as has also loblolly pine, the principal tree in the operations of the southern lumber companies, which are beginning to look upon their forest holdings as part of their capital from which successive crops should be secured.



GROWING TIMBER AS A FARM CROP.

Trees for cutting every year. Combined shelterbelt and woodlot planted by John Tetlow, Downs, Kans., who for several years has secured from it his fuel and the posts necessary for the fences of a 320-acre farm: 1. Black locust, 3 years old from seed, for planting. 2. Trees 6 years old. 3. Future fuel supply; cottonwood 8 years old, 7 inches in diameter and 50 feet high. 4. Black locust 17 years old, diameter 11 inches, height 36 feet. 5. Black locust 33 years old, average height 33 feet, diameter, 5.7 inches; by good care at the first the trees are started to growing vigorously, and are cut for fence posts and fuel ahead of the borers; an earlier crop of fuel was secured from cottonwood planted in mixture. 6. Sprouts 3, 5, and 6 years old from trees cut for posts; the largest are now approaching merchantable size.

BETTER UTILIZATION OF YELLOW PINE.

At present not more than 50 per cent of the southern pine comes to the market in material of value. For many years effort has been made, with gradually increasing success, to utilize by distillation methods the defective logs and high stumps, which are rich in turpentine, and the slabs, edgings, and sawdust. The variety of methods employed, which are often faulty, and the lack of uniformity in the product, together with an objectionable odor, have caused wood turpentine to be considered an adulterated material, or, at least, a poor substitute for gum spirits. Through conferences and experiments, however, these difficulties are being overcome. Steam distilled turpentine is found to be superior to that from the destructive distillation process. It is estimated that 30,000,000 gallons of turpentine, worth $14,000,000, can be produced from the waste wood of one year.

PRESERVATIVE TREATMENT OF RAILROAD TIMBERS.

The increase in the number and size of railroad treating plants during the year has been phenomenal. The scarcity of suitable timbers for railroad ties, combined with the high prices which they consequently command, is one of the reasons for the remarkable increase in the number of railroads which are beginning to treat and use the inferior timbers found along their own lines.

Increase in number of railroad treating plants.

1902	1903	1904	1905	1906	1907
7	10	13	15	15	27

Reports of the American Railway Engineering and Maintenance of Way Association show that the railroads which have been pioneers in treating timber have found it a paying investment. The Chicago and Northwestern Railway erected a tie plant in 1903, and since then has been treating hemlock and tamarack at the rate of about 600,000 ties a year, and now treats also beech, birch, and maple. The Santa Fe Railway has laid 13½ million treated ties, and the records show the average life of those first laid to have been 10.62 years. When, in 1904, a considerable amount of main-line track in New Mexico was washed out and replaced temporarily with untreated ties, treated ties were substituted as soon as they could be obtained, and the untreated ties were sent to the plant for treatment. According to the latest report, a total of 12,000,000 ties annually, or 12 per cent of the total cut, are now treated.

INCREASED EDUCATIONAL FACILITIES.

The progress of the year in forest education has been not so much in the establishment of new professional schools as in the strengthening of existing courses and the addition of new ones in established schools. The older schools, such as Yale, Biltmore, Michigan, and Harvard, have made steady growth. In fact, no previous year has witnessed such great success in outlining thorough theoretical and practical courses, and in securing the ablest men to conduct them. This development in the educational field has given new departments of forestry to institutions which formerly had only courses on forest subjects, and added new men specially prepared to give instruction in particular subjects. As a result, the student's opportunities to secure technical forest training are better than ever before. Although a trip through the well-managed European forests and, even better, supplementary schooling abroad are of decided advantage, it is nevertheless true that for practical forest work under American conditions the forest student no longer need go abroad for his training. Like Yale, the schools of the universities of Michigan and Minnesota, as well as Colorado College, now have summer schools. During the year courses in forestry have been established at the University of Washington, the Washington State Agricultural College, Pennsylvania State College, and the Winona Agricultural Institute, Lake Winona, Ind., and a series of lectures has been begun at the Agricultural College of Utah. Practical work at the Michigan Agricultural College has been promoted by a grant of 40,000 acres of woodland by the State for forest demonstration, at Harvard by the gift, for a similar purpose, of a 2,000-acre tract of forest land at Petersham, Mass., and at the Pennsylvania State College by the conversion of several acres of the college domain into a demonstration farm woodlot. A six-weeks course in forestry has been added to the curriculum of the Connecticut Agricultural College at Storrs. The number of graduates from American forest schools, by years, is as follows:

1899	1900	1901	1902	1903	1904	1905	1906	1907
3	3	7	24	33	42	50	56	66

ADVANCE IN NATIONAL FOREST MANAGEMENT.

The National Forests, of which there are now (April 1, 1908) 164,963,555 acres, are constantly being used in more ways and by more people. Added experience is making possible the classification of the forests by types, with general instructions concerning the systems of cutting best calculated to secure in each type the production of the most wood of the best quality. In carrying out some of the timber sale contracts utilization is now almost as complete as in a German forest. The lumbermen who are cutting timber under regulation on the National Forests are competing in the market with those who cut outside—a direct argument that conservative forestry is thoroughly practicable from the lumberman's point of view.

The third year of systematic fire control recorded an improvement of 40 per cent over 1906 and 65 per cent over 1905.

Reduction of loss by fire on the National Forests.

	1905.	1906.	1907.
Area of National Forests......acres..	97,711,455	127,167,271	162,023,190
Area of forest burned over......do....	388,872	115,416	109,410
Value of timber burned......	......	......	$31,590

Marked progress has also been made in securing prompt communication between the comparatively few men charged with the custody of wide areas. At present 1,185 men must guard 160,000,000 acres, an average of 135,000 acres, or 211 square miles, for each man. Ranger's cabins have been erected, and roads, trails, telephone lines, and bridges have been constructed.

The roads and telephone lines greatly assist in controlling fires, especially with the aid of lookout stations, which are established at strategic points. A typical example will illustrate how important are these improvements as means of overcoming distance in the administration of the forests. In the Southern Division of the Cabinet Forest there are two lookout stations, from which, with the aid of field glasses, nearly a million acres are visible. The system of patrol provides that once or twice each day, and constantly during the danger seasons, rangers shall scrutinize the forest from these lookouts. Notice of a fire can be sent by telephone, and the roads, trails, and bridges make it possible to obtain help promptly.

Construction of permanent improvements on the National Forests in 1907.

State or Territory.	Area of forests on which improvements were made in 1907.	Trails.	Roads.	Bridges.	Telephone line.	Fence.	Cabins.	Barns.
	Acres.	*Miles.*	*Miles.*	*Number.*	*Miles.*	*Miles.*	*Number.*	*Number.*
Arizona......	11,470,870	91	1	1	107	24	29	8
California......	23,082,994	485	......	46	733	33.5	60	12
Colorado......	15,748,772	166	14	16	470	104.5	63	6
Idaho......	20,336,487	454	30	50	291	24	55	11
Montana......	20,402,676	283	15	21	569	42.5	85	21
Nebraska......	556,072	......	......	......	95	1	2	1
Nevada......	2,528,479	......	1	......	......	2	4	2
New Mexico......	8,303,979	182	8	14	67	64.5	42	4
Oklahoma......	60,800	......	......	......	15	1	......	1
Oregon......	16,463,535	613	44	25	373	107	27	8
South Dakota......	1,263,720	......	......	......	13	5	9	4
Utah......	7,415,832	106	3.5	6	116	23	34	4
Washington......	12,065,500	333	7	17	135	17	22	2
Wyoming......	8,998,723	24	12	3	216	19	19	2
Total......	141,698,379	2,737	135.5	199	3,200	368	451	86

The regulation of the range by the Government has proved a decided success. No longer hustled from one place to another in competition for insufficient feed, stock is now brought through to the end of the summer in better flesh and with fewer losses than formerly. During 1907 improvement of the range by protection was supplemented by experimental investigations to determine how the amount of forage can be increased; how plants of little value can be replaced by others more useful; how poisonous plants

can be got rid of or their effect upon stock counteracted by treatment; and to plan a system of handling stock that will result in the most economic utilization of the forage crop.

Experiments in seeding portions of the range with cultivated grasses were begun, and careful detailed study was made of typical range areas to learn under what conditions the best native grasses propagate most successfully. An experimental pasture was constructed where the action of sheep under various systems of handling could be investigated and the effect of each system upon the forage crop ascertained.

FORESTRY IN THE STATES.

The year 1907 was characterized by larger opportunity than ever before for the practice of forestry under State organization. Delaware, Kentucky, Missouri, and Mississippi are better acquainted with their forest resources, by reason of forest surveys conducted in cooperation with the Forest Service. Taxation, now the most difficult problem in State forest work, is receiving thoughtful attention. At the unusually large and enthusiastic annual meeting of the Michigan Forestry Association, held at Saginaw in November, foresters from the Lake States and from Canada conferred on this and other questions, and in January a similar conference was held in New York. A study on the ground, to learn how present tax laws affect the profitableness of forest investments and how they are regarded by the people, has been inaugurated in New Hampshire by that State and the Forest Service in cooperation. If each of the States with a forest organization could contribute the figures of the stumpage for the State the work of securing a timber census of the whole country would be greatly simplified.

Some results of State forest work.

State.	Fire patrol.			Nurseries.	
	No. of wardens.	Annual expenditure.	Damage from fires in 1907.	Location.	Trees grown.
California	572	$5,500	$420,000		
Connecticut	400	464		Union tract, Tolland County.	White pine.
Hawaii	51			Nuuanu Station, Tantalus Forest.	Ironwood, blue gum (eucalyptus), black wattle, silk oak.
Indiana				Henrysville	Black locust, catalpa.
Kansas				Ogallah, Dodge City	Honey locust, osage orange, catalpa, ash, elm.
Maine	250	2,000	5,830		
Massachusetts	320			Amherst	White pine, white ash.
Maryland	53	100	50,000		
Michigan				Roscommon	White, red, and western yellow pine, Norway and red spruce.
Minnesota	1,700	1,500	30,000	Pillsbury tract, Itasca State Park.	Norway spruce, white pine.
Mississippi				Agricultural College	Black locust, hickory, osage orange, catalpa, southern pines.
New Jersey	272	a3,513	11,647	Bass River tract	White pine.
New York	b 746	7,500	9,610	Saranac Inn Station, State Fish Hatchery, Wawbeek, Axton.	White, Scotch, and red pine (nearly all promising species in small quantities).
Ohio				Wooster, Lancaster, Carpenter.	Catalpa, ash, yellow poplar, white pine, black locust, Norway spruce.
Pennsylvania	60	(c)	(d)	Greenwood, Huntingdon County; Asaph, Tioga County; Mont Alto, Franklin County.	White and Scotch pine, European larch, Norway spruce, balsam fir, hardwoods.
Rhode Island			15,000		
Vermont	e 240		2,225	Burlington	White pine.
Washington	100	f9,424	54,600		
Wisconsin	308	1,500	(d)		

a $2,813 by the State; $700 by township.
b Town fire wardens, 133; district fire wardens, 613.
c Expenditure for patrol not segregated; appropriation for administration, $125,000; for land purchase, $250,000.
d Not yet compiled; in 1906, for Pennsylvania, $70,070.
e First selectman of each town.
f The expenditure in 1906 was $11,500, and the damage reported, $294,430.

Some results of State forest work—Continued.

State.	Number of trees in nursery.	Planting.			Area of State forests.
		Trees distributed in 1907.	Trees planted in State forests.	Total number of trees planted under direction of forester.	
					Acres.
California					3,800
Connecticut	1,000,000	300,000	50,000	400,000	1,400
Hawaii	30,000	20,100			397,687
Indiana	300,000		800,000		2,000
Kansas	179,500	*a* 83,964			
Maine					
Massachusetts	300,000	57,400			
Maryland					1,957
Michigan	2,000,000	65,000	150,000	650,000	39,000
Minnesota		(*b*)			42,800
Mississippi	50,000			26,000	
New Jersey	25,000		30,000	75,000	9,867
New York	*c* 1,674,750		450,000	2,633,100	1,548,450
Ohio	512,000	138,046		138,046	
Pennsylvania	2,388,800		(*d*)	215,000	761,000
Rhode Island				10,000	
Vermont	350,000	30,000			
Washington					
Wisconsin					300,000

a Distributed by station at Ogallah: The per cent living at the close of the year were honey locust, 68; osage, 66; catalpa, 73; ash, 68; elm, 80.
b Minnesota expends $20,000 annually in bounties for tree planting on prairie-land.
c Four-year transplants, 470,350; 3-year-olds, 239,100; 2-year-olds, 65,300; 2-year-old seedlings, 640,000; 1-year-old seedlings, 860,000.
d Total number not at hand; number planted in 1907, 50,000.

During the year the State of Alabama created a forest commission, which has been organized and has begun work. The provisions of a new and excellent forest law are briefly stated under "Forest legislation" (p. 574). Of especial importance is the clause which provides for exemption from taxation for ten years of small areas which bear a young and growing stand of timber, provided the land is protected from forest fires. Bulletin 1, "Forestry and Forest Preservation in Alabama," has already been issued by the commission.

Prominent among the projects carried forward by the State forester of California was the publication of a comprehensive bulletin on the commercial production of eucalyptus. Preservative treatments of cedar, pine, and fir ties and poles, conducted in cooperation with the Forest Service at Los Angeles, showed that a 40-foot pole, worth $7.50, can be preserved with creosote at a cost of $2 so as to secure additional service worth several times the additional cost. The State fire patrol was materially strengthened.

In Connecticut 50,000 trees were planted in the Union forest, and fire lines were constructed. In the Portland forest 8,000 trees were planted and thinning was made. The State nursery has been increased to a capacity of a million trees, part of which will be ready for distribution at cost price to landowners this spring, and part two years later. In 1906 about 100,000 seedlings were furnished private owners, and in 1907 three and one-half times as many. Perhaps 1 per cent of the area of the State is owned by private parties or corporations now practicing at least crude methods of forestry. A forest survey of the State has been started. The forest-fire warden system has been developed and proved efficient in preventing fires. During the first year of the service, reports were received from 66 towns. In 35 of these 88 fires were reported, of which 64 were extinguished by the wardens and their assistants, at a total expense of $464.56, or an average of $7.25 per fire. The expense to the State was $116, to the counties $116, and to the 22 towns in which the fires occurred $232.28, or an average of $10.55 per town. Forty-five of these fires occurred in April and 25 in May, while the rest were scattered through the year.

Georgia's interest in forestry is manifest in the advancement of the course in forestry in the State University to a department, and in systematic educational work by the newly formed State forest association, which issues a publication, "Southern Woodlands." The result of a study of Georgia's forest resources, with maps, has been published.

FIRE PATROL AND SILVICULTURE IN STATE FOREST WORK.

1. Beds of white ash seedlings, ready for distribution, in the Massachusetts State Nursery. 2. Fire wagon, the latest equipment for fighting forest fires in Pennsylvania. 3. Students of the Pennsylvania State Forest Academy responding to a fire call; an important part of the training is to learn the surest and quickest methods of extinguishing forest fires. 4. Underplanting white birch with pine and spruce seedlings in the Adirondack Preserve. 5. Possibilities of second growth in New England; white pine, 50 years old, recently thinned with a profit of $44.32 per acre under the direction of the Connecticut State forester.

Hawaii, early to take up forestry, conducts systematic practical work along two main lines—the maintenance of protection forests on important watersheds and the planting of waste and barren areas with useful trees. Lectures are given by the superintendent of forestry before the students of the College of Agriculture. An examination was made during 1907 of the forest back of Hilo, Hawaii, which it was found necessary to preserve as a protection to a watershed. It has been demonstrated that rubber grows well in Hawaii, and a large area will be planted with rubber trees, which afford a good forest protection to the land. A Hawaiian corporation has agreed to furnish an American railroad with 500,000 ohia cross-ties yearly for the next five years.

The State University of Illinois, at Urbana, has an interesting experimental plantation, and the State Normal School at De Kalb has established one more recently.

Among the varied activities of the Indiana forestry commission, none is more productive of better results than the encouragement of planting, by experiments conducted on the State reserve and by published information on forestry in general and on the success of those who are growing timber in Indiana.

In Iowa the professor of forestry at the State College carries on experiments and State work. Among the problems now under consideration are the improvement of planted groves and natural woodlots, the determination of what are the most valuable species for general woodlot planting, the best methods of planting and handling the woodlot, and the development of simple methods of preservative treatment which can be carried out economically by the farmer.

Since the establishment of the Fort Hays experiment station, in west central Kansas, a series of experiments has been started, in the very center of the Plains region, in growing young trees according to various cultural methods on upland and bottomland on a scale large enough to lend authoritativeness to the results. The State forestry stations at Ogallah and Dodge City are directing their chief efforts to the distribution of young trees in the westernmost counties.

Through cooperation between the State of Kentucky and the Forest Service, a study was made of the present timber supply of the eastern part of Kentucky, the rate of consumption, and other facts which would be of value in formulating a State forest policy.

Under the Louisiana forest law police jurors of the parishes (similar to county commissioners in other States) are also fire wardens. A campaign of education is being conducted to emphasize the necessity of preserving the forests. The absence of disastrous fires in 1907 is encouraging.

In Maine another year of comparatively light damage from forest fires gives additional testimony to the value of patrol. In the establishing and maintaining of lookout stations Maine has taken an advanced step, and present experience indicates that for successful control of fires the money can not be expended in a better way. Increased registration of forest students at the State University—a total of 45 students—is evidence that forestry is to have a much wider application in woodlot and timberland management. The junior class will plant 10,000 white pine seedlings this spring. Practical work is also gained in making thinnings in the university woodlot of 100 acres.

A State forest survey, conducted by the State forester in conjunction with the examination of timber tracts for private owners throughout the State, has awakened new interest in forest preservation in Maryland, and inquiries are met by the publication of circulars which deal with practical State problems. Arrangement has been made for a series of experiments in the preservative treatment of fence posts, to be carried on by the Maryland State experiment station in cooperation with the Forest Service. Fence posts of the kinds of wood which grow in commercial quantities in Maryland will be treated by different methods and set on the station grounds, where they will be subject to frequent inspection.

The State forester of Massachusetts issued, besides the annual report, the following publications: The Commonwealth of Massachusetts Forest Laws; Brief Instructions to Massachusetts Forest Wardens; How and When to Collect White Pine Seed; Forestry from the Commercial Standpoint; The Commercial Forest Trees in Massachusetts; The Study of Trees in Our Primary Schools; and Forest Laws Concerning Railroads. Forest-fire notices were printed and posted. An offer was made by the State forester to supply, for $1, express paid, 150 white pine and 150 white ash 2-year-old trees (Pl. LXV, fig. 1) for one-fourth acre planting in Massachusetts. The demand was so great that only half-orders could be filled. Schools were offered the following for $1: Twelve white pine seedlings, 2 years old; 24 white ash seedlings, 2 years old; 12 red spruce seedlings, 2 years old; 5 beech seedlings; one-half ounce of white pine seed; 12 chestnuts; 25 acorns; and 50 white ash seed. Sample plats have been established in all but four of the counties of the State, to study the yield and rate of growth of white pine. A State forest map has been prepared and an estimate made of the total forest areas, classified by types in each town and county. A study was made of the white pine blight.

In Michigan, during the fiscal year 1906–7, dead timber to the value of over $3,000 was sold from the State forest reserve. Over 60 miles of fire lines have been built. Owing to the efficiency of the fire patrol, no fires occurred this year. The plantations of the Saginaw forest farm, at Ann Arbor, are becoming a valuable object lesson, not only for school and experimental purposes, but for the general public. The Cleveland Cliffs Iron Company has increased its staff of foresters and is planning reforestation on a large scale. On the Ausable River, on Manitou Island, and at Cedar Lake landowners are carrying on extensive reforestation. Two investors at Grayling are purchasing lands and making preparations to convert these into regularly managed forest properties. The forestry commission distributed over 60,000 seedlings for experimental plantations among various landowners in the State. Forest sentiment among the people, among legislators, and with the press is steadily growing. One of the best illustrations was the enthusiastic meeting of the Northern Michigan Press Association at Traverse City, where an entire evening was devoted to forestry, and reforestation was strongly advocated.

The forest law of Minnesota of 1895 made town supervisors fire wardens under direction of a chief fire warden, who, among other duties, was required to make an annual report, including "important facts relating to forest interests." The annual appropriation to execute the law is $11,000. The legislature of 1907 placed Itasca State Park, at the headwaters of the Mississippi, under charge of the forestry board, appropriated $2,000 a year for demonstration work there and $1,500 for fire breaks, development, and improvements. It also appropriated $2,500 for planting on the Pillsbury Reserve the 3-year-old Norway spruce seedlings which the board had raised on that reserve. An area of 185 acres was thus planted at an expense of $6.50 per acre. In 1906 the board imported 20,000 white pine seedlings from Germany, which were planted the same spring on the Pillsbury Reserve.

During the fall of 1907 the Forest Service cooperated with the geological survey of Mississippi in an examination of cut-over longleaf pine lands. These lands are, with few exceptions, in wretched condition, because of recurring fires. Since they will not be needed for agriculture for many years, they should in the meantime be reproducing pine, to prolong an industry that means much to the State. In 1906 Mississippi ranked third in yellow pine production, cutting more than 1,500,000,000 board feet, or 13 per cent of the yellow pine cut. This business, with its attendant market for farm and other products, will soon be lost without fire prevention.

As a result of cooperative forest studies in the Ozark region of southern Missouri and western Arkansas, between the State of Missouri and lumber companies on the one hand and the Forest Service on the other, one large lumber company which controls in the aggregate four billion feet of standing timber has begun the application of forest management to its holdings.

Nebraska has begun to reap the fruits of early forest work, and the past year has manifested that many of the apparent failures of former years were in reality important lessons in the selection of proper species and methods of planting under peculiar conditions. The number of students in the different courses of forestry in the University of Nebraska shows a healthy growth. In addition to the regular courses a special course is given for public school teachers, and during the year a course for advanced students and courses of lectures on silvics and State forest policy have been inaugurated. The permanent equipment of the department of forestry has been enlarged, and now includes, among other additions, a forest herbarium, a large collection of wood specimens, and a portable sawmill for practical demonstrations upon the timber grown by provident farmers of that vicinity.

The forest survey of New Hampshire has not only made available information about the forests, but has greatly stimulated the practice of forestry. Dartmouth College now has a tract of 26,000 acres in the northern part of the State under forest management, and about 1,000,000 board feet a year are cut with care for reproduction. The water boards of Concord, Nashua, and Hanover are applying forest methods to tracts of 350, 700, and 1,000 acres, respectively. Sixty plantations of white pine have been made, one of them, at Manchester, comprising 25 acres. As an experiment, 240 acres at Winchester have been sowed by the broadcast and the spot methods.

During the past year New Jersey has developed a definite policy. The forest commission is actively working for the betterment of the woodlands of the State, to establish values in forest lands, and to make them continuously productive. The means employed are control of forest fires and instruction of woodlot owners. The State contains numerous forest areas of considerable size, but for the most part the work concerns itself with the intensive management of woodlots for the production of ties and lumber for nearby markets. During the one year of its operation the fire service has succeeded in reducing the acreage burned and the damage done to woodlands to less than one-tenth that of any former year. This has already affected

favorably the market price of forest property. The commission has acquired about 11,000 acres of land for State reserves, and will develop the property as demonstration areas and public parks. It recognizes, however, that the private owner has, and will continue to have, the greatest interest in this question, and will, therefore, devote every effort to make such lands valuable and productive.

The New York State nurseries, in April and May, 1907, contained 549,450 4-year-old transplants of white pine, Norway pine, Scotch pine, Norway spruce, and European larch, ready for planting. In addition, an importation has been made from Germany to complete an even million trees, to be set out this spring. A crew of 100 men, under the charge of two professional foresters, will do the work (Pl. LXV, fig. 4). A 10-acre nursery will be established in central New York for propagating stock for free distribution and to furnish shade trees for the good-roads system. A new feature is the creation of a patrol of the Adirondack railroads during the spring months. This contemplates a force of 100 men, distributed along the steep railroad grades and at places in the forest where conditions are the most dangerous. This railroad patrol is entirely separate from the fire-warden system, the patrols being paid directly from the Albany office. At the end of the year the railroads refund to the State one-half the expense. During the summer of 1907 seed-spot sowing was carried on, and a field experiment station started. Fifteen species of seeds have been planted in various ways. The most hopeful experiment is one in which seed is dropped on the unbroken ground at 5-foot intervals, and the seed at each spot covered with a handful of sand. Western yellow pine seed planted in this way produced trees in nearly every spot. An experiment was made with white pine, by putting a handful of black muck on the unbroken ground, placing a few seeds on the muck, and covering the seed with sand.

During the past year forest work in North Carolina has been confined to the swamp lands near the coast, which are owned by the State board of education. After an examination most of these forest lands were withdrawn from sale until it could be definitely determined whether it is better to sell the land outright, to sell the timber on the stump and have it cut under the supervision of a forester, or to sell all the timber and clear the land for agricultural purposes. In a number of cases it is evidently the better policy to keep the forests and make them a perpetual source of income to the State. These examinations have also encouraged the drainage of swamp lands, especially a 44,000-acre tract which belongs to the State, part of which is good forest land. A forester has been employed, who will carry out plans regarding the State lands and take up questions regarding general State forestry. The State owns 700,000 acres of forest land, and its forest interests are second only to those of agriculture.

A very successful plan in Ohio of cooperating with landowners in establishing plantations and maintaining their timber tracts in such condition that they will serve as educational examples in correct forest practice has been extended until practically every county in the State has been covered. This includes the preparation of plans for managing woodlots and timber tracts and the furnishing of planting material which will be grown according to plans and instructions furnished. A total of 466 farmers are thus cooperating with the State experiment station. A State forest survey has been begun.

The Pennsylvania department of forestry has during the past year directed most of its attention and energy to the acquiring of new land, the establishing of good nurseries, and the pushing of reforestation work. The State now holds in forest reserve lands about 10 per cent of the area of timberland of the Commonwealth. The nursery area has been increased to over 12 acres, and in another year the number of seedlings will be more than doubled. There are at present, in three nurseries, a total number of 2,250,000 seedlings, of which about 8 per cent are hardwoods, the remainder being conifers, mostly white pine. The reserves are being improved and roads are being opened and built in order to make the land accessible and to serve as fire lines. Special attention is paid to the control of forest fires, and losses are very greatly decreasing (Pl. LXV, figs. 2 and 3). Fire-killed timber is utilized. A successful experiment with small fire-killed timber was made some time ago in the burning of charcoal. A forest academy is maintained directly by the Department for the training and education in forestry of young men of the State for work on the forest reserves, and to speak to public schools, teachers' institutes, and farmers' institutes. The school has made wonderful development and has now under construction a new and thoroughly modern red stone building to be used for dormitory and lecture rooms, together with thoroughly equipped laboratories.

The second annual report of the State forester of Rhode Island discusses general forest conditions, methods of lumbering, stumpage prices, and the problems of forest taxation and fires. The report states that the 250,000 acres of unimproved land of the

State should yield 40,000,000 board feet of lumber and 125,000 cords of fuel per annum, worth $1,175,000. The present income from this source, according to the State census of 1905, is $697,593. Landowners have applied for advice in the management of a woodland aggregating 2,250 acres.

The State experiment station of Vermont issued a bulletin entitled "Forest Planting in Vermont," which will greatly promote the practice of forestry. The State nursery has been increased in capacity for supplying plant material to farmers in the State, and to avoid delay while stock is growing here seedlings have been secured from the New York State nurseries.

The progress of forest work in Washington for the past year is especially marked by increased activity on the part of the State and owners of timberlands to protect the timber from fire, the inauguration of forest instruction at the University and at the Agricultural College at Pullman, and the better appreciation by the people of the National forest policy. The work of the deputy fire wardens in the several counties of the State entirely prevented destructive timber fires. About one hundred forest rangers were appointed, usually at the request of mill men and timberland owners by whom they were employed. At a meeting of prominent lumbermen in Seattle a ranger service was organized for the fire season of 1908. This organization represents some 4,000,000 acres of timberland, and it is the plan to assess holdings at the rate of 1 cent an acre for fire protection. Other timber holders of the State are doing something in the same line. One company, for example, has a force of men in the field which is as effective as the State force.

The West Virginia State Board of Trade has appointed a committee to investigate State forest conditions and recommend to the State legislature the enactment of laws which will promote forest preservation.

During 1907 the most important forest work in Wisconsin was the appraising and selling of scattered and agricultural lands and the use of the proceeds to purchase other lands suitable only for forestry, so as to consolidate the main forest reserves on the headwaters of the Wisconsin and Chippewa rivers. About 15,000 acres have recently been purchased. Concessions have been granted private capitalists to store water at the headwaters of streams, the promoters to reap benefit from the sale of waterpower. Much interest centers in this attempt of private capital to establish reservoirs which will operate in conjunction with the forest cover in the regulation of streams.

FOREST LEGISLATION.

More new and amendatory forest legislation was enacted by the State legislative assemblies from December 1, 1906, to December 1, 1907, than during any previous year. The following is a brief summary of the laws passed by Congress and the State legislatures during that period:

United States.—Salary of the Forester increased from $3,500 to $5,000 per annum (34 Stat., 1269); $100,000 appropriated to continue surveys of National Forests (34 Stat., 1336); $25,000 for Appalachian and White Mountain survey and report (34 Stat., 1281); Forest reserves to be known hereafter as National Forests (34 Stat., 1269); Forest reserve special fund abolished, and annual appropriation for National Forests increased from $900,000 to $1,900,000 as compensation; payment of expenses incurred for protection and care of fish and game supplied to stock National Forests was authorized; purchase of technical books and journals for officers outside of Washington authorized (34 Stat., 1270); creation of new and additions to existing National Forests in Oregon, Washington, Idaho, Montana, Colorado, or Wyoming forbidden, except by act of Congress (34 Stat., 1271); certain townships in Black Hills National Forest placed within operation of agricultural settlement act of June 11, 1906 (act of February 8, 1907, 34 Stat., 883); certain National Forest lands granted to the cities of Durango, Colo. (34 Stat., 1053), and Boulder, Colo. (34 Stat., 1223), for water-supply purposes.

Alabama.—State commission of forestry created, to serve without compensation or expense to the State; governor authorized, upon recommendation of commission of forestry, to accept gifts to State of lands to be administered as State forest reserves, commission to investigate and report annually on forest conditions and recommend legislation; county game and fish wardens declared forest wardens with authority of peace officers, and all peace officers ex officio forest wardens; appointment of deputy forest wardens without compensation authorized; owners of land not exceeding assessed value of $5 per acre allowed to contract with commission of forestry to plant and protect timber trees on such land, and secure its exemption from taxes for ten years. Counties authorized to appropriate $250 annually as salary for their forest warden; provisions enacted against setting and spread of fires, use of engines without spark arresters, and attaching electric wires to, or, without consent of mayor, mutilating

trees along streets; moneys received as penalties and from State forest reserves to constitute forest reserve funds, available for forest administration; $500 annually appropriated; consent of State given to acquisition by the United States of land for a National Forest (act approved November 30, 1907).

California.—Substance of Penal Code, sections 384, 384a, and 384b, incorporated in and enlarged upon by amendment of section 384; stringent regulations against setting and spread of fires, use of engines without spark arresters, and blasting wood during "dry season" without permit from State or district fire warden; rendering assistance to fire warden made compulsory; one-half of fines to be paid to forest fund (ch. 536, laws of 1907); $5,000 appropriated (ch. 177, laws of 1907), to be expended under direction of State department of engineering (ch. 183, sec. 13, laws of 1907) in cooperation with United States Forest Service in construction of fire lanes and trails for protection of the south slope of the San Bernardino Mountains.

Connecticut.—Section 1221, general statutes, amended to increase surrounding space, which must be cleared before a fire is started (ch. 43, laws of 1907); sections 3, 4, and 5, chapter 238, public acts of 1905, amended, making fire chiefs in consolidated town and city governments ex officio fire wardens and improving fire regulations (ch. 136, laws of 1907).

Florida.—Cutting, removing, or working in any manner for turpentine purposes any timber forbidden under penalty of fine or imprisonment or both when any tax-sale certificates are outstanding and unredeemed against the land or timber or the turpentine privileges on such lands (ch. 5683). Approved June 3, 1907. Penalty for unauthorized, willful cutting, scraping, destroying, or injuring of standing trees, title to which is in another, made the same as for theft of personal property of equal value (ch. 90, laws of 1907).

Idaho.—Sections 10, 11, 12, and 13 of House bill 131 (laws of 1905, p. 145) repealed; provision made for division of State into fire districts, and appointment, with police powers, of district fire wardens to be paid by property owners requesting such appointment; a "close season" and stringent and comprehensive fire regulations established; clearing of railroad rights of way required; posting of fire laws and regulations provided (H. B. 61, session laws of 1907, p. 18).

Indiana.—Granting of rights of way over State forest reservation, laboratory of forest demonstration, and nurseries, to railroads, telegraph, and telephone companies provided (ch. 57, laws of 1907).

Kansas.—Appointment of two commissioners of forestry, each to be in charge of one of the two State forest experiment stations, provided for. Duty of each commissioner to devote entire time to improvement of his forestry station and to investigation and experiment; to furnish seedlings free to residents of the State; to disseminate information, and upon petition of 25 persons to hold meetings in any county. Expenses and salary of $1,000; $5,600 per year appropriated (ch. 405, laws of 1907).

Maine.—Specification 10, section 6, chapter 9, revised statutes (forest land exemption), amended to exempt from taxes, under certain conditions, such timber lands *hereafter* planted and cultivated (ch. 169, laws of 1907).

Massachusetts.—Salary of State forester increased from $2,000 to $3,000; new provisions as to his expenditures (ch. 473, laws of 1907); sections 16 and 20, chapter 32, revised statutes, amended; sections 17, 18, and 22, chapter 32, and section 14, chapter 53, repealed; appointment of forest wardens in cities and towns provided for, and expenditure of $2,000 annually on forest warden conventions, including traveling expenses of wardens, authorized (ch. 475, laws of 1907); commissioners on fisheries and game given power to arrest those found unlawfully setting fire (ch. 299, laws of 1907).

Michigan.—Office of State game, fish, and forestry warden created, with combined duties of game and fish warden, commissioner of State land office as forest commissioner, and chief fire warden; salary of $3,000 and expenses (act 106, laws of 1907); special commission of inquiry on tax lands, forestry, forest fires, and forest legislation created, expenses paid, no salary (act 188, laws of 1907); fire warden law of 1903 repealed; new act providing township supervisors to be fire wardens; not exceeding 10 district deputy game, fish, and forestry wardens, with $1,000 salary, police power in enforcing fire laws, and power to employ assistance (act 317, laws of 1907); lands of State agricultural College in Iosco and Alcono counties withdrawn as forest reserve (act 299, laws of 1907).

Minnesota.—Section 2205, revised laws of 1905, amended; governor ex officio member of State forestry board (ch. 171, laws of 1907); $2,500 appropriated for planting evergreens on Pillsbury Reserve, Cass County (ch. 351, laws of 1907); Itasca State park made a forest reserve under State forestry board; $2,000 appropriated for demonstration work on said reserve, and $1,500 for fire breaks and other improvements; board of regents of State University authorized to undertake forestry work in conjunction with State forestry board (ch. 90, laws of 1907).

Montana.—State game and fish warden and deputies made ex-officio State fire warden and deputies with duty to protect the timber within the State and especially that owned by the State from fire. May employ men in emergencies and incur necessary expenses. Authority to arrest for violation of fire laws (ch. 147, laws of 1907).

New Jersey.—State board of forest park reservation commissioners authorized to change fire districts and appoint wardens at joint expense of State and townships (ch. 9, laws of 1907); to acquire certain lands as part of State forest park reservation and make rules and regulations (ch. 143, laws of 1907).

New York.—Section 229, forest, fish, and game law of 1900, as amended by chapter 186, laws of 1903 (fire penalty) further amended by reducing minimum penalty (ch. 667, laws of 1907).

Oregon.—A nonpartisan State board of forestry created to investigate forest conditions, suggest legislation, and supervise and give publicity to matters pertaining to forestry; may incur $500 expenses, but receive no compensation; property owners willing to pay forest wardens may secure appointment of citizens as such; State and county officials and resident officers of National Forests may be appointed ex officio forest wardens; a "close season" established, during which fire can not, except under special precautions and subject to special liability, be used without permit from a State fire warden; permits contain restrictions and are revocable for cause; stringent legislation enacted against setting and spread of fire; use of spark arresters and clearing of railroad rights of way required; chapter 227, general laws of 1905, repealed (ch. 131, laws of 1907).

Pennsylvania.—Constables and employees of department of forestry made fire wardens with power to compel assistance; two-thirds of compensation and expense to be repaid to the county by the State; $40,000 appropriated by the State (ch. 86, laws of 1907); special provisions for protection of forest lands containing oil and gas wells (ch. 334, laws of 1907).

Rhode Island.—Allowance for traveling expenses of commissioner of forestry, together with cost of printing and supplies, reduced from $500 to $300 (ch. 1465, laws of 1907).

Tennessee.—Duties of department of game, fish, and forestry, respecting trespass, forestry, and forest fires, defined; special provisions against trespass and spread of fire by engines and charcoal burners; certain lands may be donated to State for forestry purposes; forest policy outlined; cooperative investigation with United States Forest Service authorized. Wardens authorized to summon emergency help for fighting fires; misdemeanor to disobey summons; $3 per day allowed for such compulsory service (ch. 397, laws of 1907).

Vermont.—Provisional appropriation of $500 per year for five years to aid Vermont agricultural experiment station in establishment and maintenance of nursery for forest seedlings; material for planting to be furnished at cost within State, and skilled assistance provided (ch. 15, laws of 1906, approved December 16, 1906).

Washington.—Annual salary of State fire warden and forester increased from $1,500 to $2,000 (ch. 201, laws of 1907).

Wisconsin.—Tax exemptions provided for certain lands devoted to forest culture (ch. 592, laws of 1907); State board of forestry authorized to appraise, preparatory to selling to United States, all State lands and timber within Indian reservations; moneys from such sales, except when otherwise disposed of by constitution, to be expended only in purchase of State forest reserves (ch. 96, laws of 1907); State may purchase lands north of town 33; $10,000 per annum appropriated (ch. 491, laws of 1907); State park board created, to work in conjunction with director of State geological survey and State forester; $500 appropriated (ch. 495, laws of 1907); in granting private corporation privilege to dam and improve Wisconsin River, certain supervision and control over its operations given State board of forestry (ch. 335, laws of 1907).

Wyoming.—Misdemeanor to light and leave fire in any woods or prairies without extinguishing (ch. 22, laws of 1907).

PLANT DISEASES IN 1907.

By W. A. Orton, *Plant Pathologist*, and Adeline Ames, *Scientific Assistant, Bureau of Plant Industry.*

This is the ninth annual summary on the distribution and prevalence of plant diseases, prepared by the Department with the assistance of the several State experiment stations, whose cooperation is gratefully acknowledged.

Mr. M. B. Waite has revised the portions relating to diseases of fruits, and Doctors Metcalf, Hedgcock, and Spaulding the section on diseases of forest and shade trees. Special assistance has also been rendered by the following collaborators of this Department in their respective experiment stations: Prof. H. L. Bolley, North Dakota; Dr. F. D. Heald, Nebraska; Mr. F. D. Kern, Indiana; Mr. W. H. Lawrence, Washington; Prof. J. B. S. Norton, Maryland; Prof. W. Paddock, Colorado; Prof. L. H. Pammel, Iowa; Dr. A. D. Selby, Ohio; Dr. F. L. Stevens, North Carolina; Dr. J. L. Sheldon, West Virginia; Dr. G. E. Stone, Massachusetts; Prof. H. H. Whetzel, New York; Dr. E. Meade Wilcox, Alabama.

Many of the common diseases, such as apple scab, bitter-rot, pear leaf blight, Monilia rot of stone fruits, bean anthracnose, etc., occur quite commonly over their geographical range every year in greater or less abundance. They are not mentioned in this report, except where some observer has noted their abundance.

POME FRUITS.

Apple.—**Bitter-rot** (*Glomerella rufomaculans* (Berk.) Sp. and von Schr.) was again much less destructive than normally, partly owing to cool and dry weather, and partly because of the unusually short crop. Traces of bitter-rot were observed as far north as Massachusetts and Rhode Island.

In the Ozarks of Arkansas, where there was a fair crop of apples, though less abundant than usual, bitter-rot appeared on certain varieties, destroying in some cases 50 per cent of the crop. Spraying experiments against this disease were repeated by Mr. W. M. Scott, of the Bureau of Plant Industry, and were again successful, and the discovery was made that the self-boiled lime-sulphur mixture was almost, if not quite, as successful as Bordeaux mixture in the prevention of bitter-rot. About 90 per cent of the fruit was saved by three applications of Bordeaux mixture or the self-boiled lime-sulphur mixture.

Black-rot or **Canker** (*Sphaeropsis malorum* Pk.) was reported as less prevalent from Ohio, West Virginia, Indiana, Kentucky, and Massachusetts. It was very common but not destructive in New Hampshire, Nebraska, Missouri, Vermont, New York, Delaware, and Maryland. See also Leaf-spot.

Blackspot canker (*Gloeosporium malicorticis* Cordley) was more severe in western and southern Oregon and was prevalent in the Puget Sound region in Washington, where it has been shown that it can be controlled by spraying with Bordeaux mixture.

Blight (*Bacillus amylovorus* (Burr.) De Toni) was as a rule considerably less destructive than last year, except in New Jersey, Maryland, and North Carolina, where it was reported worse. Epidemics also occurred in the Grand Forks and Park River valleys of North Dakota and in Nevada.

Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) was reported to occur in Nebraska and North Carolina. It continues as a rare disease of the apple over most of the country.

Crown-gall occurred generally throughout the apple districts of the United States. In nurseries it was less abundant the past season. Evidence concerning the relationship of soft crown-gall of apple, pear, blackberry, and rose with that of the stone fruits has been published by Dr. G. G. Hedgcock, of the Bureau of Plant Industry (B. P. I. Bul. 131, part 3).

European canker (*Nectria ditissima* Tul.) was reported from New Hampshire.

Fly-speck (*Leptothyrium pomi* (Mont. and Fr.) Sacc.) and **Sooty-blotch** (*Phyllachora pomigena* (Schw.) Sacc.) were observed in Nebraska, New Hampshire, West Virginia, Missouri, Delaware, Rhode Island, Connecticut, Ohio, Massachusetts, Maryland, and Indiana, and were reported for the first time from western Washington.

Fruit-blotch (*Phyllosticta solitaria* E. and E.). This fungus, reported last year by W. M. Scott as *Phyllosticta* sp., was identified as *P. solitaria* E. and E. by Dr. J. L. Sheldon (Science, vol. 26, p. 183). It occurred as a serious spot of the fruit in Arkansas, Illinois, Missouri, North Carolina, and West Virginia, but less than last year. Scott and Rorer (Proc. Benton Co. Hort. Soc. 1907) and Dr. Sheldon (loc. cit.) have both shown that it occurs on twigs, producing small cankers. That practically complete control of this disease could be secured by three or four treatments with the

standard 5-5-50 Bordeaux mixture was again demonstrated last season in Arkansas by Scott.

Hairy-root is the most common form of root disease in nurseries in all parts of the United States. The stem tumor occurring on apple and quince in orchards has been proven to be a form of hairy-root by Dr. G. G. Hedgcock, of the Bureau of Plant Industry (B. P. I. Circ. 3).

Illinois canker (*Nummularia discreta* (Schw.) Tul.) was reported from West Virginia and Nebraska.

Leaf-spot, hitherto usually attributed to *Phyllosticta pyrina*, has been shown by W. M. Scott (B. P. I. Bul. 121, part 5) to be caused by *Sphaeropsis malorum.* The Phyllosticta following on these spots is not parasitic, and Dr. J. L. Sheldon has shown that it has olive-brown spores and should be called *Coniothyrium pirini* (Sacc.) Sheldon (Torreya, vol. 7, p. 142).

Leaf-spot was present in Delaware, Indiana, North Carolina, Nebraska, New Hampshire, Ohio, Massachusetts, Maryland, and Rhode Island. In part of Pennsylvania and western Maryland it continued to be so severe as to demand spraying for its control.

Physiological fruit-spot was reported from Connecticut, Massachusetts, and New Hampshire.

Powdery mildew (*Sphaerotheca mali* (Duby) Burr) was reported from Kentucky. It was more serious than usual in California and probably also in the other Western States.

Rot (*Penicillium glaucum* Lk.). This is the common blue mold found practically everywhere on decaying apples.

Volutella rot, a new rot due to a new species (*Volutella fructi* Stevens and Hall), has been found by Dr. F. L. Stevens and Mr. J. G. Hall in a number of localities in North Carolina and is described by them in Journal of Mycology, vol. 13, p. 94, and in Bulletin 196, North Carolina Agricultural Experiment Station.

Another form of fruit-rot attributed to *Coniothyrium fuckelii* Sacc. has been found in North Carolina by the same writers.

Rust (*Gymnosporangium macropus* Lk., etc., I) was more or less common in Delaware, Kentucky, New Jersey, New York, Iowa, Nebraska, North Carolina, Ohio, Massachusetts, Oklahoma, Maryland, and West Virginia. Dr. F. D. Heald has shown that the "cedar apple" stage of this fungus on red cedar is biennial rather than annual as heretofore supposed.

Scab (*Venturia inaequalis* (Cke.) Aderh.) was less abundant than usual in New York and Michigan, but worse in New Hampshire and quite serious in Maine. It was also less abundant than usual in Maryland, West Virginia, Virginia, and west to Arkansas, and was more abundant than usual in Iowa. The failure of the apples over wide areas kept the loss from being as pronounced as usual.

Scurf (*Phyllosticta prunicola* (Opiz) Sacc.), a new bark disease of apple, is described by Dr. F. L. Stevens in Bulletin 196, North Carolina Agricultural Experiment Station.

A new disease caused by *Hypochnus ochroleucus* Noack., reported hitherto from Brazil only, has been found by Dr. F. L. Stevens in the mountains of North Carolina (Science, vol. 26, p. 724). It occurs on leaves and twigs of apple, pear, and quince.

Spray injury was more frequent than usual. Cases were reported from Maryland, West Virginia, New York, Pennsylvania, and Delaware.

Winter injury. The early fall frosts caused serious damage to the apple in Michigan and Ohio. The spring frosts—more especially the prolonged cold weather during the blooming period over a wide range from Kansas, Nebraska, and Missouri eastward, including all the country except part of New York, part of Pennsylvania, and parts of Virginia and West Virginia—were so unfavorable to the setting of fruit as to produce the greatest shortage of apples that has occurred in recent years.

PEAR—**Blight** (*Bacillus amylovorus* (Burr.) De Toni) continued its destructiveness in the Sacramento Valley of California, where a large part of the pear industry has been seriously crippled. In the foothills of California, the lower Sacramento Valley, and districts around San Francisco, the blight was slightly less severe and is being controlled to a considerable extent by eradication methods. It has entered the Rogue River valley of southern Oregon. It was very destructive in Utah, Texas, Oklahoma, Missouri, and Georgia. It occurred in Idaho.

Leaf-blight (*Entomosporium maculatum* Lév.) was rather less serious than usual over much of the eastern United States on account of the cool weather.

Leaf-spot (*Septoria piricola* Desm.) was reported from Ohio, Nebraska, and Massachusetts. It is rather common over much of the eastern United States, but is usually obscured by the more prevalent leaf-blight.

Rust (*Gymnosporangium* sp.) was observed in New Jersey and Oregon.

Scab (*Venturia pirina* Aderh.) was mentioned from Indiana, Massachusetts, Maryland, Rhode Island, Ohio, and Washington.

QUINCE.—**Black-rot** (*Sphaeropsis malorum* Pk.) was reported from Indiana, Ohio, and Maryland.

Blight (*Bacillus amylovorus* (Burr.) De Toni) was reported from Massachusetts and Ohio only.

Leaf-spot (*Entomosporium maculatum* Lév.) occurred in Delaware, Kentucky, Ohio, Massachusetts, and Maryland.

Rust (*Gymnosporangium* sp.) caused considerable loss in Massachusetts, being more abundant than in many years.

STONE FRUITS.

CHERRY.—**Black-knot** (*Plowrightia morbosa* (Schw.) Sacc.) was more severe in Vermont and New York, and was reported from Massachusetts, New Jersey, Maryland, New Hampshire, and Ohio.

Brown-rot (*Sclerotinia fructigena* (P.) Schrt.) was less abundant than usual, according to reports from Massachusetts, New York, Ohio, and Nebraska.

Leaf-spot (*Cylindrosporium padi* Karst.) was more destructive in Washington and caused considerable injury locally in Indiana and Nebraska. It occurred in Kentucky, Ohio, Massachusetts, Delaware, Tennessee, and North Carolina.

Powdery mildew (*Podosphaera oxyacanthae* (DC.) De By.) was reported from Nebraska, Missouri, New York, Ohio, and Washington.

PEACH.—**Black-spot** (*Cladosporium carpophilum* Thüm.) was less prevalent because of late frosts killing the fruit in many sections of the country. It was reported from Alabama, Texas, Delaware, Oklahoma, Indiana, Missouri, Iowa, Ohio, Nebraska, West Virginia, and Washington. It was more abundant than usual in Maryland.

Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) was less prevalent. It was destructive in Oklahoma, and in Alabama and Maryland where there were peaches, and it destroyed 50 per cent of the crop in Missouri. It caused serious losses in Georgia, especially on the latter part of the crop. A small amount was observed in Rhode Island, Nebraska, and Ohio. It was also reported from Indiana, West Virginia, Tennessee, and Illinois.

Crown-gall, until recently attributed to a slime-mold (*Dendrophagus globosus* Toum.), has been shown by Drs. C. O. Townsend and Erwin F. Smith to be of bacterial origin (Science, vol. 25, p. 643). This organism (*Bacterium tumefaciens*) causes crown-gall on daisy, raspberry, and other hosts as well. It was reported prevalent in Alabama, Colorado, Delaware, Florida, Georgia, Maryland, Nebraska, Ohio, and West Virginia.

Die-back (*Valsa leucostoma* Pers.), a new disease injuring peach and Japanese plum twigs in Missouri, is described by F. M. Rolfs in Science, vol. 25, p. 87.

Frost injury.—An early autumn freeze of unusual severity occurred in Michigan on October 10, 1906. It caught the peaches in full leaf and with even late fruit on the trees. Many trees were injured, and a section several miles in extent toward the southern end of the lake shore peach belt had the trees killed outright.

Frosty mildew (*Cercosporella persicae* Sacc.) occurred in North Carolina. It was less abundant in Arkansas.

Gumming disease, or California peach blight (*Coryneum Beyerinckii* Oud.), continued its disastrous attacks in the peach orchards of California. Like the previous season, it was very severe, in many cases destroying 90 per cent of the crop. Spraying experiments by Mr. M. B. Waite, of the Bureau of Plant Industry, again demonstrated the possibility of its complete control. The methods advocated by the Department were widely practiced in the treatment of the disease. Where spraying was thoroughly done and where it was begun before December 15 the results were excellent.

Leaf-curl (*Exoascus deformans* (Berk.) Fckl.) was unusually severe in parts of California, particularly the Santa Clara Valley. It occurred in New Jersey, Rhode Island, and Ohio and was especially destructive in New York. It was reported less severe in Delaware, Georgia, New Hampshire, Indiana, Idaho, Iowa, Maryland, Massachusetts, and Nebraska.

Little peach was slightly less abundant than usual in Michigan and western New York. It was found by Mr. Waite to occur definitely and to a serious extent in southern New York and New Jersey. In the latter State at least one orchard has been entirely destroyed by the disease.

Powdery mildew (*Sphaerotheca pannosa* (Wallr.) Lév. and *Podosphaera oxyacanthae*, (DC.) De By.) was reported from Utah and Colorado, and was more abundant than usual in Nebraska.

Pustular spot (*Helminthosporium carpophilum* Lév.) was reported as usual in Ohio.

Root-rot was unusually prevalent in Texas, Oklahoma, and probably other Southern States last year.

Rosette occurred in Georgia, Missouri, and Oklahoma.

Rust (*Puccinia pruni* Pers.) was reported from Florida and Iowa. It was abundant in southern California.

Yellows was rather less abundant than usual in Michigan and western New York. Over a wide area of the Eastern States, including Connecticut, southern New York, eastern Pennsylvania, New Jersey, Delaware, Maryland, Virginia, and probably eastern Tennessee, there was a general outbreak of yellows. It has been increasing in this area for the past two seasons at least, until in many sections it has destroyed the orchards entirely and has become a great epidemic in that area. Many entire orchards and sometimes all the orchards in a county have been actually wiped out, at least commercially speaking. Other districts have had more than usual, so much so as to be dangerous, but owners still maintain their orchards, particularly by eradication methods. There is a tendency along the southern portion of this belt for the disease to spread to the southward into new territory. In much of this area it was serious twenty to thirty years ago, and has been more prevalent during the past season, or perhaps the past two seasons, than it has ever been since that time.

PLUM.—**Black-knot** (*Plowrightia morbosa* (Schw.) Sacc.) was present in Indiana, Iowa, Maryland, Massachusetts, New Hampshire, New Jersey, Oklahoma, and Ohio. It caused serious injury locally in Nebraska and is increasing in Vermont, Rhode Island, and Delaware because of lack of treatment.

Black-spot (*Cladosporium carpophilum* Thüm.) was reported from Iowa.

Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) was injurious in western Washington, Indiana, and Vermont, and destroyed a large portion of the crop of Japanese plums in Maryland. It was reported from Delaware, New Hampshire, Nebraska, Massachusetts, New York, and Ohio.

Leaf-spot (*Cylindrosporium padi* Karst.) occurred in Iowa, Kentucky, Ohio, and Indiana, but caused little injury.

Plum-pockets (*Exoascus* sp.) were more prevalent in Ohio, were reported from a number of localities in Iowa and Nebraska, and were observed occasionally in Rhode Island and Vermont.

Powdery mildew (*Podosphaera oxyacanthae* (DC.) De By.) was reported from Iowa.

Rust (*Puccinia pruni* P.) was prevalent in Oklahoma.

SMALL FRUITS.

BLACKBERRY.—**Anthracnose** (*Gloeosporium venetum* Speg.) was reported from Massachusetts, Missouri, Ohio, and Michigan, and was the cause of much injury in western Washington.

Crown-gall was present in Maryland, New Jersey, and Massachusetts. It injured 50 per cent of the crop in Washington.

Leaf-spot (*Septoria rubi* Westd.) was reported from Delaware, Ohio, Nebraska, and Missouri.

Rust (*Gymnoconia interstitialis* (Schl.) Lagh.) was generally prevalent in Delaware, Indiana, Kentucky, Louisiana, Massachusetts, New Jersey, Maryland, Ohio, Virginia, New York, and Oklahoma.

CRANBERRY.—**Anthracnose** (*Glomerella rufomaculans vaccinii* Shear) occurred in Massachusetts, New Jersey, and Wisconsin.

Hypertrophy (*Exobasidium oxycocci* Rostr.) caused considerable loss on Cape Cod.

Rot (*Acanthorhyncus vaccinii* Shear) prevailed as usual in New Jersey and Massachusetts.

Scald (*Guignardia vaccinii* Shear) occurred in New Jersey and Massachusetts as usual.

Sclerotinia oxycocci Wor. is increasing in Wisconsin.

The above and numerous minor troubles are fully described by Dr. C. L. Shear, of the Bureau of Plant Industry, in Bulletin 110.

A physiological trouble reducing fruitfulness has caused loss in Wisconsin (20th Rept., Wis. Cranberry Growers' Assn., p. 20).

CURRANT.—**Anthracnose** (*Gloeosporium ribis* (Lib.) Mont.) caused considerable injury in New York.

Cane blight (*Nectria cinnabarina* (Tode) Fr.) was reported from Ohio and Rhode Island.

Leaf-spot (*Cercospora angulata* Wint. and *Septoria ribis* Desm.) occurred in Iowa, Maryland, Nebraska, New Jersey, Ohio, Wisconsin, and Rhode Island.

Powdery mildew (*Sphaerotheca mors-uvae* (Schw.) B. and C.) occurred in Ohio.

Rust (*Puccinia ribis* DC.) was reported from Nebraska.

Knot (*Pleonectria berolinensis* Sacc.) was reported from Ohio and Maryland.

GOOSEBERRY.—**Leaf-spot** (*Septoria ribis* Desm.) was prevalent in Kentucky, Maryland, Massachusetts, Nebraska, and Ohio, but was of only minor importance.

Powdery mildew (*Sphaerotheca mors-uvae* (Schw.) B. and C.) occurred in Kentucky, Maryland, Nebraska, Idaho, New Jersey, Ohio, Rhode Island, and Washington.

GRAPE.—**Anthracnose** (*Sphaceloma ampelinum* De By.) was prevalent in Oklahoma, Missouri, Indiana, and Michigan.

Black-rot (*Guignardia bidwellii* (Ell.) V. and R.) was very destructive in Michigan; less so in Ohio. Considerable loss occurred in New Jersey, and a large percentage of the Scuppernong crop in North Carolina was destroyed by an attack of black-rot before the blooming period. The disease was much less prevalent in New York, Massachusetts, Maryland, and Delaware.

Downy mildew (*Plasmopara viticola* (B. and C.) Berl. and De Toni) was injurious in Kentucky and Georgia and was present but unimportant in Vermont, Ohio, Massachusetts, Maryland, West Virginia, Louisiana, Iowa, and Delaware.

Crown-gall was reported from Ohio, Pennsylvania, and Michigan.

Powdery mildew (*Uncinula necator* (Schw.) Burr.) was reported as spreading in Colorado and as occurring in Iowa, Maryland, Idaho, Missouri, Massachusetts, Nebraska, Ohio, and Washington.

Root-knot (*Heterodera radicicola* (Greef) Mül.) was found by Dr. E. A. Bessey on *Vitis vinifera* in southern California.

RASPBERRY.—**Anthracnose** (*Gloeosporium venetum* Speg.) was generally prevalent in Maryland, Missouri, Kentucky, Ohio, Michigan, and New Jersey. It injured 50 per cent of the crop in Wisconsin and was considerably worse in Illinois.

Crown-gall caused serious injury locally in Delaware and Maryland and was reported from Ohio.

Leaf-spot (*Septoria rubi* Westd.) was reported from Indiana, Nebraska, Ohio, and Michigan.

Rust (*Gymnoconia interstitialis* (Schl.) Lagh.) occurred locally in Nebraska, Louisiana, Indiana, and West Virginia.

STRAWBERRY.—**Leaf-spot** (*Sphaerella fragaria* (Tul.) Sacc.) was more serious in New Hampshire. It was reported from Iowa, Washington, Missouri, Delaware, Nebraska, New Jersey, and Ohio.

TROPICAL FRUITS.

AVOCADO.—**Anthracnose** (*Colletotrichum gloeosporioides* Penz.) was less prevalent in southern Florida than last year.

CITRUS FRUITS.—**Anthracnose**, or **Wither-tip** (*Colletotrichum gloeosporioides* Penz.), caused more injury than usual in Florida, the disease resistance of the plants being reduced by drought.

Blight seemed to be gaining in Dade County, but was about the same in other parts of Florida.

Die-back was less prevalent, owing to better treatment of groves.

Frenching, a form of chlorosis not due to any organism, caused much more injury in southern Florida.

Gumming of grape-fruit was more severe.

Root-rot (*Fusarium limonis* Briosi) prevailed as usual on wet soil in Florida.

Scab (*Cladosporium* sp.) was less prevalent in Florida because of the dry season.

Scaly bark, a new disease of citrus fruits described by H. S. Fawcett (Rept. Fla. Agr. Expt. Sta. 1907, p. xliii), attacked 25 per cent of the crop in Florida.

FIG.—**Fruit-rot** (*Colletotrichum* sp.) was reported from Louisiana.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) was common on figs in the Southern and Southwestern States, and was reported by Dr. E. A. Bessey, of the Bureau of Plant Industry, from Texas, Arizona, and New Mexico.

Rust (*Uredo fici* Cast) was reported from Florida and caused more damage than usual in Louisiana.

LOQUAT.—**Anthracnose**, or **Blossom blight** (*Colletotrichum* sp.), was more prevalent in southern Florida.

MANGO.—**Anthracnose** (*Colletotrichum gloeosporioides* Penz.), because of dry weather, was less prevalent in southern Florida.

PAPAYA.—**Fruit-rot** (*Colletotrichum* sp.) occurred in southern Florida.

VEGETABLE AND FIELD CROPS.

ASPARAGUS.—**Rust** (*Puccinia asparagi* DC.) occurred more or less throughout the country; reported on the increase in Connecticut, Illinois, Colorado, and Missouri.

BEAN.—**Anthracnose** (*Colletotrichum lindemuthianum* (Sacc. and Magn.) Bri. and Cav.) was much less prevalent in the bean-growing districts of New York. It was reported worse in West Virginia and Illinois, but as a rule was less troublesome than in 1906. A slight occurrence was reported from Colorado, Washington, and California.

Bacterial spot (*Bacterium phaseoli* Erw. Sm.) was reported from Delaware, New Jersey, Nebraska, Louisiana, and Wisconsin.

Blight (Rolf's *Sclerotium*) caused some injury in Louisiana.

Downy mildew (*Phytophthora phaseoli* Thax.) was reported locally from Maryland, but was absent from Connecticut this year.

Leaf spots (*Phyllosticta phaseolina* Sacc. and *Cercospora* sp.) were reported as causing slight injury in Louisiana.

Rust (*Uromyces appendiculatus* (Pers.) Lév.) occurred in North Carolina, Louisiana, Delaware, New Jersey, Massachusetts, Iowa, and Alabama.

Stem and pod rot (*Rhizoctonia* sp.) caused considerable loss in Louisiana.

BEET.—**Crown-rot** (*Phoma betae* Frank) was reported from Colorado and Kansas.

Curly-top was in evidence as usual but did comparatively little damage in Utah and Colorado.

Leaf-blight (*Cercospora beticola* Sacc.) seemed to be generally prevalent. It was serious in Colorado, Kansas, and eastward.

Nematode disease (*Heterodera schachtii* Schmidt), a dreaded pest in Europe, has been found by Dr. E. A. Bessey, of the Bureau of Plant Industry, in sugar-beet fields in California and Utah.

Rhizoctonia root-rot occurred in Ohio.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) was found by Dr. E. A. Bessey to be seriously injuring sugar beets in Colorado, Utah, and California.

Stem Nematode (*Tylenchus dipsaci* Kühn) was found by Dr. E. A. Bessey in a few fields in Kansas.

CABBAGE.—**Black-rot** (*Bacterium campestre* (Pam.) Erw. Sm.) was reported as more or less destructive in Delaware, Indiana, Minnesota, Iowa, Kentucky, Alabama, Maryland, New York, Massachusetts, Nebraska, Ohio, Texas, New Jersey, West Virginia, Vermont, Louisiana, and for the first time in Arizona.

Club-root (*Plasmodiophora brassicae* Wor.) occurred in Massachusetts, New Jersey, North Carolina, Ohio, Vermont, and Washington, and was unusually severe in New York, causing losses of from 10 to 50 per cent.

Downy mildew (*Peronospora parasitica* (Pers.) De By.) was more prevalent in Maryland and Ohio and was reported from North Carolina, New York, and Delaware.

Wilt (*Fusarium* sp.) was received from Maryland and reported from North Carolina.

CASSAVA.—**Leaf-spot** (*Cercospora cassavae* E. and E.) was more prevalent in Florida.

CANTALOUPE.—**Anthracnose** (*Colletotrichum lagenarium* (Pass.) Ell. and Hals.) caused considerable injury in Massachusetts and Vermont and was reported from New Jersey.

Downy mildew (*Pseudo-peronospora cubensis* (B. and C.) Rostr.) was reported as causing less injury than usual in Connecticut, Massachusetts, and Ohio.

Leaf-blight (*Alternaria brassicae* var. *nigrescens* Pegl.) was decidedly injurious in the cantaloupe districts of Indiana and Colorado, reducing the crop and injuring the quality of the later pickings. In the Eastern States it appeared to be less prevalent.

Wilt (*Bacillus tracheiphilus* Erw. Sm.) was reported from Wisconsin, Indiana, Kentucky, and Maryland.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) was reported from North Carolina.

CAULIFLOWER.—**Black-rot** (*Bacterium campestre* (Pam.) Erw. Sm.) caused considerable damage. It prevailed generally in Ohio, Alabama, and Louisiana and was reported locally from Texas and North Carolina.

CELERY.—**Leaf-blight** (*Cercospora apii* Fres.) occurred in Delaware, Massachusetts, New Jersey, Ohio, and Rhode Island, but caused little injury. It was quite destructive locally in Maryland and Illinois and prevailed in southern California, though most of the loss there is believed to be due to the Septoria leaf-spot.

Leaf-spot (*Septoria petroselini* Desm. var. *apii* Br. and Cav.) was reported from Massachusetts. An unusual epidemic prevailed in the celery district of southern California, where 800 carloads are estimated to have been lost.

Heart-rot caused heavy losses in Florida and was reported from Ohio.

COLLARDS.—**Leaf-blight** (*Alternaria brassicae* (Berk.) Sacc.) and **wilt** (*Fusarium* sp.) occurred in North Carolina.

Black-rot (*Bacterium campestre* (Pam.) Erw. Sm.) was destructive in Alabama.

CUCUMBER.—**Anthracnose** (*Colletotrichum lagenarium* (Pass.) Ell. and Hals.) was quite prevalent in the Norfolk, Va., region, and was reported from Massachusetts, New Hampshire, Nebraska, New Jersey, North Carolina, and Vermont.

Damping-off (*Pythium De Baryanum* Hesse. and *Rhizoctonia* sp.) occurred in greenhouses in Ohio.

Downy mildew (*Pseudo-peronospora cubensis* (B. and C.) Rostr.) was locally prevalent in Kentucky, North Carolina, and Florida, and caused much injury in Louisiana and South Carolina.

Mosaic in greenhouses was reported from Ohio.

Scab (*Cladosporium cucumerinum* Ell. and Art.) was serious in Wisconsin, where its prevalence for the past three seasons has resulted in the abandonment of some pickling factories.

Wilt (*Bacillus tracheiphilus* Erw. Sm.) was more prevalent in Connecticut, New Hampshire, and Massachusetts, and occurred in Kentucky, Ohio, and Indiana.

EGG PLANT.—**Anthracnose** (*Gloeosporium melongenae* Ell. and Hals.) occurred locally in Ohio.

Blight (*Bacterium solanacearum* Erw. Sm.) occurred occasionally in Ohio and Indiana.

Fruit-rot (*Phyllosticta hortorum* Speg.) was reported from Louisiana, Nebraska, and New Jersey.

Leaf-spot (*Ascochyta lycopersici* Brun.) occurred in Delaware.

GINSENG.—**Blight** (*Alternaria* sp.) caused losses of 15 to 20 per cent in New York.

Stem anthracnose (*Vermicularia dematium* (Pers.) Fr.) was sent in from Tennessee.

Bordeaux injury, caused by spraying immediately before cold weather, caused losses of 20 per cent in New York (Whetzel, Special Crops, n. s., vol. 6, No. 62).

GOLDENSEAL.—**Alternaria blight** occurred on 5 to 10 per cent of the crops in New York.

Stem-rot (*Botrytis* sp.) was more severe in New York.

HORSE-RADISH.—**Leaf-blight** (*Ramularia armoraceae* Fckl.) was received from Wisconsin.

Leaf-spot (*Cercospora armoraceae* Sacc.) was reported from Nebraska.

LETTUCE.—**Anthracnose** (*Marsonia perforans* E. and E.) was sent in from greenhouses in Michigan.

Downy mildew (*Bremia lactucae* Regel.) was reported from Ohio.

Drop (*Sclerotinia libertiana* Fckl.) occurred in Florida, Texas, and North Carolina and injured 20 per cent of the crop in Ohio.

Rosette (*Rhizoctonia*) and **tip-burn** were reported from Ohio.

OKRA.—**Root-knot** (*Heterodera radicicola* (Greef.) Mül.) and **wilt** (*Neocosmospora vasinfecta* (Atk.) Erw. Sm.) were reported from Alabama.

ONION.—**Brittle** seemed to be more general in Connecticut this year.

Downy mildew (*Peronospora schleideniana* De By.) appeared to be less prevalent in the Eastern States, but was quite injurious in western Washington and Oregon and in California.

Smut (*Urocystis cepulae* Frost) occurred in Georgia, Ohio, and Massachusetts.

PARSLEY.—**Crown-rot** (*Sclerotinia* sp.) caused a loss of 50 per cent of one crop in Louisiana and was reported locally from Texas.

PARSNIP.—**Leaf-spot** (*Cercospora apii* var. *pastinacae* Fres.) was mentioned as destructive locally in Nebraska.

PEA.—**Ascochyta blight** (*Ascochyta pisi* Lib.) was reported from Nebraska, New Jersey, Ohio, and North Carolina.

Powdery mildew (*Erysiphe polygoni* DC.) was prevalent in New Jersey, Iowa, Connecticut, Ohio, and Louisiana, but not destructive.

PEANUT.—**Leaf-spot** (*Cercospora personata* (B. and C.) Ell.) was collected in Alabama and North Carolina and reported as causing slight injury in Louisiana.

PEPPER.—**Anthracnose** (*Gloeosporium piperatum* Ell. and Ev.), **blight** (Rolf's Sclerotium), and **leaf-spot** (*Cercospora* sp.) were reported from Louisiana.

POTATO.—**Black-leg** (bacterial) occurred in Texas, Virginia, Maryland, Colorado, New York, Vermont, and Maine.

Dry-rot (*Fusarium oxysporium* Schlecht.) caused serious loss in Colorado and several localities in Washington. It was less prevalent in New York, Ohio, and Massachusetts.

Early-blight (*Alternaria solani* (E. and M.) J. and G.) was considerably more prevalent in the northern potato belt from New York through Ohio, Indiana, and Illinois to Wisconsin, where the loss from the premature death of the foliage is estimated at $1,000,000. Tipburn was largely associated with the early-blight fungus in causing this injury.

Leaf-blotch (*Cercospora concors* (Casp.) Sacc.) was again reported from Vermont as causing minor injuries.

Late-blight (*Phytophthora infestans* De By.) developed in two well-marked epidemics, one in the potato belt of northern Maine, where the loss from blight and rot was greater than for several years past, the other in northern Delaware, Pennsylvania, and Maryland. Late-blight does not often occur to any extent in this section, but considerable rot developed the past fall. In Vermont and southern New England, New York, and the North Central States, there was extremely little late-blight, owing to dry weather. Several reports were received from west of Puget Sound in Washington and from western Oregon.

Rhizoctonia disease (*Corticium vagum* B. and C. var. *solani* Burt.) was much less prevalent in Colorado this year. It was reported from Washington.

Scab (*Oospora scabies* Thax.) seems to occur wherever potatoes are grown. New York reported a greatly increased prevalence in 1907.

ROSELLE.—**Powdery mildew** (*Microsphaera* sp.) was very common in Florida. It was shown that dusting with sulphur is a remedy.

SALSIFY.—**White-rust** (*Albugo tragopogonis* Tul.) was reported as destructive locally in Nebraska.

SPINACH.—**Downy mildew** (*Peronospora effusa* (Grev.) Rabh.) was reported to have caused serious loss in one irrigated field in New Mexico.

SQUASH.——**Bacterial wilt** (*Bacillus tracheiphilus* Erw. Sm.) was collected in Wisconsin. A Fusarium wilt was reported from North Carolina.

SUGAR CANE.—Dr. L. Lewton Brain reports the following diseases from Hawaii:

Eye-spot of leaf (*Cercospora sacchari* V. Breda.) was more prevalent.

Pineapple disease (*Thielaviopsis ethaceticus* Went.) was about usual, but was successfully treated with Bordeaux mixture.

Red-rot of stem (*Colletotrichum falcatum* Went.) was not common.

Rind disease (*Melanconium sacchari* Massee.) was widely distributed but decreasing. It injured 1 per cent of the crop.

Ring-spot of leaf (*Leptosphaeria sacchari* Br. d. H.) was not important.

Clathrus root-disease (*Clathrus* sp.) was confined to Kauai.

Ithyphallus root-disease (*Ithyphallus coralloides* Cobb.) affected 2 to 10 per cent of the crop.

Marasmius root-disease (*Marasmius sacchari* Wak.) occurs with the foregoing but is less important.

A root disease ascribed by H. R. Fulton to *Marasmius plicatus* Wak. was found on about 5 per cent of the cane in Louisiana.

SWEET POTATO.—**Black-rot** (*Ceratocystis fimbriata* Ell. and Hals.) was reported from Indiana, New Jersey, Ohio, and Tennessee.

Dry-rot (*Lasiodiplodia tubericola* Ell. and Ev.) was reported from Florida.

Soil-rot (*Acrocystis batatas* Ell. and Hals.) was reported from New Jersey.

Soft-rot (*Rhizopus nigricans* Ehrb.) was reported from Nebraska.

Stem-rot (*Nectria ipomoeae* Hals.) was on the increase in southern Illinois and occurred in New Jersey and southern Ohio.

White-rust (*Albugo ipomoeae-panduranae* (Schw.) Swingle) was reported from Delaware.

TOBACCO.—**Bed-rot** (*Rhizoctonia*) caused considerable loss in Ohio but was controlled by formalin treatment.

Mosaic disease was more prevalent in Kentucky, Massachusetts, and Ohio.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) caused serious trouble in North Carolina.

Root-rot (*Thielavia basicola* Zopf.) was not as troublesome in Connecticut. It occurred locally in Ohio and Kentucky.

Wilt, bacterial, occurred as usual in North Carolina.

TOMATO.—**Anthracnose** (*Colletotrichum phomoides* (Sacc.) Chest.) occurred in New Jersey, Delaware, and Nebraska. It was very destructive in several localities in West Virginia.

Bacterial blight (*Bacterium solanacearum* Erw. Sm.) was mentioned as occurring in Delaware, Louisiana, and Maryland.

Leaf-mold (*Cladosporium fulvum* Cke.) was present late in the season in Massachusetts and injured 10 per cent of the crop in New Hampshire

Leaf-spot (*Septoria lycopersici* Speg.) was less prevalent according to reports from Delaware, Illinois, Maryland, New Jersey, North Carolina, and Ohio. It caused considerable injury locally in Nebraska and West Virginia.

Mosaic disease was observed in Connecticut.

Point-rot was more prevalent in Alabama, New York, and Connecticut. It also occurred in California, Indiana, Maryland, and North Carolina.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) occurred in Alabama.

Western blight prevailed as usual in Washington and was reported from Nevada.

Wilt (*Fusarium* sp.) was more destructive in Colorado and attacked 50 per cent of the crop in Louisiana. It occurred in Texas, Arizona, and California.

TURNIP.—**Downy mildew** (*Peronospora parasitica* (Pers.) De By.) was sent in from Maryland.

WATERMELON.—**Anthracnose** (*Colletotrichum lagenarium* Ell. and Hals.) was reported from New Jersey, South Carolina, and Ohio. It was again very destructive in the Ohio Valley, especially in West Virginia, but was controlled where spraying was practiced.

Downy mildew (*Pseudoperonospora cubensis* (B. and C.) Rostr.) was reported from Ohio.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) caused serious losses where melons were planted in old fields in South Carolina and Alabama.

Wilt (*Bacillus tracheiphilus* Erw. Sm.) was reported from Long Island and New Jersey.

Wilt (*Neocosmospora vasinfecta* var. *nivea* Erw. Sm.) occurred in the Southern States as usual. It is increasing in southern Indiana, eastern Iowa, and in the melon districts of Kansas and Oklahoma. It has nearly stopped melon growing in certain localities in western Oregon, central and southern California, and Arizona.

CEREALS.

BARLEY.—**Ergot** (*Claviceps purpurea* (Fr.) Tul.) occurred to a small extent on *Hordeum distichum* in Nebraska.

Leaf-rust (*Puccinia simplex* (Koern.) Erikss. and Henn.) did little or no damage in Minnesota and adjacent States.

Stem-rust (*Puccinia graminis* Pers.) caused losses in Iowa estimated by Prof. Pammel at 20 per cent of the crop. In Minnesota, however, but little loss occurred.

Scab (*Fusarium culmorum* (Sm.) Sacc.) occurred to a small extent in Nebraska.

Covered smut (*Ustilago hordei* (Pers.) Kell. & Sw.) was very common and increasingly destructive in the Great Plains States, but proved controllable by seed treatment. Untreated fields in Nebraska contained 25 per cent of smut, whereas treated fields had only 0.5 per cent.

Loose-smut (*Ustilago nuda* (Jens.) Kell. & Sw.) was common and troublesome in the Great Plains area, especially in the northern half. The loss in Wisconsin in 1907 is estimated at $1,000,000, and in Iowa at 1 per cent of the crop.

Yellow leaf disease (*Helminthosporium gramineum* Rabh.) was reported from Nebraska and from Iowa.

CORN.—**Dry-rot** (*Diplodia* sp.) caused a loss of 2 per cent in Illinois, as compared with 4 per cent in 1906; was also reported from Ohio (J. T. Barrett, Science, n. s., vol. 27, p 212).

Leaf-blight (*Helminthosporium inconspicuum* E. & E.) was reported from Georgia as universal in some fields, and from Ohio as widespread.

Rust (*Puccinia sorghi* Schw.) was reported in Iowa, Kentucky, Louisiana, Ohio, Maryland, and Nebraska.

Smut (*Ustilago zeae* (Beckm.) Unger) was generally prevalent but was as usual epidemic only in heavily manured fields or in fields continuously in corn.

MILLET.—**Spot** (*Cladosporium* sp.) attacked 5 per cent of the crop in Iowa.

Smut (*Ustilago crameri* Körn.) occurred locally in Ohio.

Leaf-blight. A yellow or reddened foliage, with heavy reduction of the yield of grain, resulted from abnormal weather and soil conditions in New York, Ohio, Indiana, Nebraska, and North Dakota.

OATS.—**Leaf-rust** (*Puccinia coronata* Cda.) and **stem-rust** (*Puccinia graminis* Pers.) were quite severe throughout the Mississippi Valley, and in the northern part were mainly responsible for the short oat crop. In the southern half of the valley insect injuries and diseases of unknown origin were associated with the rusts.

Scab (*Fusarium culmorum* (W. G. Sm.) Sacc.) was slightly more prevalent in Iowa.

Smut (*Ustilago avenae* (Pers.) Jens.) prevailed as usual. It was reported as especially destructive in Wisconsin and western Washington.

RICE.—**Black-smut** (*Tilletia horrida* Tak.) occurred to a slight extent in Louisiana.

Blast (*Piricularia* sp.) was more prevalent than last year in South Carolina and Louisiana (H. Metcalf, Science, n. s., vol. 25, p. 264).

Green-smut (*Ustilaginoidea virens* (Cke.) Tak.) occurred in Louisiana but did not cause serious loss.

RYE.—**Ergot** (*Claviceps purpurea* (Fr.) Tul.) seemed more abundant. It injured 2 per cent of the crop in Iowa and was reported from New York, Ohio, and Michigan.

Rusts (*Puccinia rubigo-vera* (DC.) Wint. and *P. graminis* Pers.) were doubtless generally present. They were reported as more prevalent in Iowa and as injuring 75 per cent of the crop in Wisconsin.

Scab (*Fusarium culmorum* (W. G. Sm.) Sacc.) occurred in Iowa.

SORGHUM.—**Blight** (*Bacillus sorghi* Burr.) was reported from Iowa and Louisiana and on broom corn in Ohio.

Head-smut (*Sphacelotheca reiliana* (Kühn.) Clint.) was serious in one locality in Illinois. Although less common than kernel smut it is spreading in parts of Kansas and Texas.

Kernel-smut (*Sphacelotheca sorghi* (Lk.) Clint.) was reported on sorghum in Alabama and Louisiana, and on kafir in Nebraska and Oklahoma. It is very widely scattered in the Great Plains area and causes considerable damage.

WHEAT.—**Powdery mildew** (*Erysiphe graminis* DC.) was unusually prevalent in Delaware, Maryland, West Virginia, Nebraska, and Ohio.

Leaf-rust (*Puccinia rubigo-vera* (DC.) Wint.) occurred throughout the country. In Iowa unusual injury (25 per cent) was reported on spring wheat, but only 5 per cent on winter wheat. It was very common in the Great Plains area, but much less abundant than in 1906. There was no conspicuous epidemic.

Stem-rust (*Puccinia graminis* Pers.) was generally very slight in amount. Considerable losses were reported on spring wheat in Iowa and in parts of Texas.

Scab (*Fusarium culmorum* (W. G. Sm.) Sacc.) was very much more prevalent in Ohio, where Professor Selby estimated the loss at $400,000. An unusual amount, estimated at 10 per cent, was found on spring wheat in Iowa, and a considerable amount in Indiana and Nebraska.

Loose-smut (*Ustilago tritici* (Pers.) Jens.) was very widespread, but as a general rule small in amount. In New York, however, it was more common in 1907 than for several years. In Ohio it was estimated to have been three times as abundant as usual. Loss of 10 to 15 per cent was reported from Washington, and heavy losses from parts of Kansas and Texas.

Stinking smut (*Tilletia foetans* (B. & C.) Tul.) occurred as usual in varying degrees in different communities, depending on whether or not seed treatment had been practiced.

FORAGE CROPS.

ALFALFA.—**Anthracnose** (*Colletotrichum trifolii* B. & E.) was reported from Tennessee.

Bacterial blight appears to be spreading in Colorado.

Dodder (*Cuscuta epithymum* Murr.) was reported as more prevalent in Ohio and New Jersey.

Downy mildew (*Peronospora trifolearum* De By.) occurred in Colorado.

Leaf-spot (*Pseudopeziza medicaginis* (Lib.) Sacc.) prevailed as usual, but caused only minor loss.

Rust (*Uromyces striatus* Schroet.) was reported from Nebraska.

BLUEGRASS.—**Rust** (*Puccinia poarum* Niels.) occurred in Maryland.

CLOVER.—**Anthracnose** (*Colletotrichum trifolii* B. & E.) occurred in Ohio, Delaware, and West Virginia. It was destructive in Tennessee, but the experiment station there has been successful in breeding resistant varieties.

Black-spot (*Phyllachora trifolii* (Pers.) Fckl.) was reported from Delaware and Alabama.

Dodder (*Cuscuta* spp.) is increasing in destructiveness in Delaware, Maryland, New Jersey, Oklahoma, and Ohio.

Leaf-spot (*Pseudopeziza trifolii* (Biv. & Bern.) Fckl.) occurred in Nebraska.

Rust (*Uromyces trifolii* (A. & S.) Wint.) occurred in Nebraska, Ohio, Delaware, Maryland, Missouri, New York, and New Jersey, but caused little injury.

Winter injury. Quite serious injury from freezing was reported from Ohio.

COWPEA.—**Wilt** (*Neocosmospora vasinfecta* var. *tracheiphila* Erw. Sm.) was reported from Louisiana, South Carolina, and Georgia.

Leaf-spot (*Cercospora cruenta* Sacc.) was reported from Delaware, Virginia, South Carolina, and North Carolina.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) was reported from North Carolina, South Carolina, Alabama, and Florida.

QUACK-GRASS.—**Smut** (*Ustilago hypodytes* (Schlecht.) Fr.) was found by Prof. Whetzel at Batavia, N. Y., destroying one-third of the heads of this grass.

TIMOTHY.—**Rust** (*Puccinia poculiformis* (Jacq.) Wettst.) was unusually prevalent in New York and occurred in West Virginia.

Smut (*Ustilago striaeformis* (West) Niessl.) occurred in Iowa and West Virginia.

VETCH.—**Spot** (*Protocoronospora nigricans* Atk. and Edg.), a new disease, has been described by Prof. Geo. F. Atkinson and C. W. Edgerton on cultivated vetch at Ithaca, N. Y. (Science, vol. 27, p. 385.)

FIBER PLANTS.

COTTON.—**Angular leaf-spot** (*Bacterium malvacearum* Erw. Sm.) prevailed about as usual throughout the cotton belt.

Anthracnose (*Colletotrichum gossypii* South.) was prevalent in Alabama, Florida, Georgia, Louisiana, South Carolina, and North Carolina. It caused considerable damage in Georgia and Alabama to seedlings as a damping-off fungus as well as by destroying the bolls.

Areolate leaf-spot (*Ramularia areola* Atk.) was reported from Alabama.

Root-knot (*Heterodera radicicola* (Greef.) Mül.) was reported from Florida, South Carolina, Alabama, and Georgia.

Texas root-rot (*Ozonium omnivorum* Shear—named in Bul. 34, Torr. Bot. Club, p. 305). This fungus occurs from eastern Texas to southern California and north to southern Oklahoma on cotton, alfalfa, cowpeas, sweet potatoes, beets, and fruit trees. It did somewhat less injury in 1907 than in 1906, owing to the fact that it appeared later in the season. C. L. Shear and G. F. Miles, of the Bureau of Plant Industry, have shown that it can be controlled by deep fall plowing combined with rotation with grasses and grains. (B. P. I. Bul. 102, part 5.)

Wilt (*Neocosmospora vasinfecta* (Atk.) Erw. Sm.) was more injurious in South Carolina, Georgia, Louisiana, and Alabama.

FLAX.—**Wilt** (*Fusarium lini* Bolley) occurred throughout North Dakota. Selection of resistant varieties and formalin treatment of seed have proved successful in combating it.

FOREST, NUT, AND SHADE TREES.

The following diseases have been reported as indicated. The common names of the host trees are according to Sudworth's Check List (Bul. 17, Division of Forestry).

ALPINE FIR.—**Heart-rot** (*Echinodontium tinctorium* E. & E.), Montana.

ASH.—**Rust** (*Puccinia fraxinata* (Lk.) Arth.), Delaware, Iowa, and Nebraska.

ASPEN.—**Leaf-blight** (*Sclerotium* sp.), Colorado.

Heart-rot (*Fomes igniarius* (L.) Gill.), Massachusetts, Vermont, New York, Colorado, Montana, and New Mexico.

Sap-rot (*Fomes leucophaeus* (Mont.), New Mexico; (*Fomes pinicola* (Sw.) Gill.), New York.

BALM OF GILEAD.—**Leaf-spot** (*Septoria populicola* Pk.), Nebraska.

BALSAM.—**Sap-rot** (*Fomes pinicola* (Sw.) Gill.), New York; and *Polystictus abietinus* (Dicks.) Quel., New York and Vermont.

BLACK WALNUT.—**Leaf-spot** (*Marsonia juglandis* (Lib.) Sacc.), Delaware, Iowa, Nebraska, and West Virginia.

BULL PINE.—**Heart-rot** (*Trametes pini* (Brot.) Fr.), California, Oregon, Montana, New Mexico, and Washington.

Leaf-blight (*Pestalozzia* sp.), Nebraska and New York.

Sap-rot (*Fomes pinicola* (Sw.) Gill., California, Oregon, Montana, New Mexico, and Washington.

Damping-off (*Fusarium* sp.), New York, Vermont, and Nebraska.

Root-rot (*Polyporus Schweinitzii* Fr.), Montana.

BUTTERNUT.—**Heart-rot** (*Fomes igniarius* (L.) Gill.), Vermont.

CATALPA.—**Leaf-spot** (*Phyllosticta catalpae* (Ell. & Mart.), Maryland, Ohio, Massachusetts, and Delaware.

Rhizoctonia sp. injured seedlings in Ohio.

CEDAR.—**Rust** (*Gymnosporangium macropus* Lk.), New York, Delaware, Ohio, Nebraska, and Iowa.

Root disease (*Poria purpureum* Fr.), Iowa.

Leaf-blight (*Pestalozzia* sp.), Tennessee.

CHESTNUT.—**Anthracnose** (*Marsonia ochroleuca* (B. & C.) Humph.), Massachusetts, Virginia, and Delaware.

Sap-rot (*Polystictus versicolor* (L.) Fr.), Virginia and District of Columbia; (*Daedalea quercina* (L.) Pers.), Connecticut.

Bark disease (*Diaporthe parasitica* Murr.) is exterminating the chestnuts in the western half of Long Island and about New York City and has been reported from a number of localities in New Jersey, Pennsylvania, Connecticut, and Massachusetts, and as far up the Hudson as Poughkeepsie, N. Y. Metcalf has reported the Japanese chestnut generally resistant to this disease. (B. P. I. Bul. 121, part 6, pp. 1–4, 1908, and also pp. 483–494 of this volume.)

COTTONWOOD.—**Rust** (*Melampsora populina* (Jacq.) Lev.), Nebraska, Louisiana, Iowa, and Massachusetts.

Sap-rot (*Fomes leucophaeus* Mont.), Nebraska,

DOUGLAS SPRUCE.—**Sap-rot** (*Fomes pinicola* (Sw.) Gill.), California, Idaho, Montana, New Mexico, Oregon, and Washington.

Heart-rot (*Trametes pini* (Brot.) Fr.), Montana and Wyoming.

Root-rot (*Polyporus Schweinitzii* Fr.), Montana and Oregon.

Freezing of young twigs was noted in New York.

ELM (species undetermined).—**Black spot** (*Dothidella ulmi* (Duv.) Wint.), Massachusetts and Nebraska.

Leaf-spot (*Phyllosticta ulmicola* Sacc.), Oklahoma; (*Phyllachora ulmi* (Duv.) Fckl.), Iowa.

ENGELMANN SPRUCE.—**Rust** (*Peridermium abietinum* E. & E.), Colorado.

Heart-rot (*Echinodontium tinctorium* E. & E.), Idaho, Montana, and New Mexico; (*Trametes pini* (Brot.) Fr.), Montana.

Sap-rot (*Fomes pinicola* (Sw.) Gill.), Montana.

Frost injury was noted on Long Island, N. Y.

ENGLISH WALNUT.—**Blight** (*Bacterium juglandis* (Pierce) Erw. Sm.), California.

GREEN ASH.—**Rust** (*Puccinia fraxinata* (Lk.) Arthur), Nebraska.

HEMLOCK.—**Heart-rot** (*Trametes pini* (Brot.) Fr.), Maine, Vermont, and New York.

Sap-rots (*Fomes pinicola* (Sw.) Gill.), Maine, Vermont, and New York; (*Fomes tsugae* (Murrill) Sacc.), New York and Vermont. (This is a new species, published by Murrill in Bul. 29, Torrey Bot. Club, pp. 601–2, 1902.)

HICKORY.—**Leaf-spot** (*Marsonia juglandis* (Lib.) Sacc.), West Virginia and Iowa.

HORNBEAM.—**Heart-rot** (*Fomes igniarius* (L.) Gill.), Vermont.

HORSE CHESTNUT.—**Leaf-spot** (*Phyllosticta paviae* Desm.), Massachusetts, New York, Rhode Island, and Connecticut.

JACK OAK (*Quercus tinctoria*).—A sterile fungus was mentioned in the Iowa reports as killing trees.

JACK PINE.—**Leaf-blight** (*Pestalozzia* sp.), Nebraska.

LOCUST.—**Heart-rot** (*Polyporus obtusus* Berk.), District of Columbia; (*Trametes robiniophila* Murr.), Missouri (a new species, described by Murrill in North American Flora, vol. 9, p. 42, 1907); (*Fomes robiniae* (Murr.), Sacc.), Missouri, Maryland, North Carolina, and New York.

LODGEPOLE PINE.—**Heart-rot** (*Trametes pini* (Brot.) Fr.), Montana and Idaho.

Sap-rot (*Fomes pinicola* (Sw.) Gill.), Montana and Idaho.

LOWLAND FIR.—**Heart-rot** (*Echinodontium tinctorium* E. & E.), Montana.

MAPLE (species undetermined).—**Anthracnose** (*Gloeosporium apocryptum* E. & E.), nurseries in New York.

Leaf-spot (*Rhytisma acerinum* (Pers.) Fr.), New Jersey, Rhode Island, Massachusetts, New York, and Vermont.

Sun-scald and **Leaf-scorch** injured trees in West Virginia, Ohio, Maryland, Pennsylvania, New York, Rhode Island, Massachusetts, and District of Columbia.

MOUNTAIN MAPLE.—**Heart rot** (*Fomes igniarius* (L.) Fr.), New York.

Sap-rot (*Fomes leucophaeus* (Mont.), New York.

MULBERRY.—**Leaf-spot** (*Cercospora moricola* Cke.), Nebraska.

Root-knot (*Heterodera radicicola* (Greef.) Mül.), North Carolina.

NEW MEXICAN LOCUST.—**Heart-rot** (*Fomes robiniae* (Murr.) Sacc.), New Mexico.

OAK (species undetermined).—**Leaf-curl** (*Taphrina coerulescens* (Desm. & M.) Tul.), Long Island, New York.

OREGON MAPLE.—**Leaf-spot** (*Rhytisma punctatum* (Pers.) Fr.), Oregon and Washington.

OSAGE ORANGE.—**Rust** (*Physopella fici* (Cast.) Arth.), Louisiana. See North American Flora, vol. 7, p. 103, 1907.

PAPER BIRCH.—**Sap-rot** (*Polyporus betulinus* (Bull.) Fr.), Connecticut and Massachusetts.

PECAN.—**Rosette**, South Carolina, Georgia, and Florida.

Scab (*Fusicladium effusum* Wint.), Florida, Louisiana, Georgia, Oklahoma, and Texas.

PITCH PINE.—**Leaf-blight** (*Lophodermium* sp.), Rhode Island, Connecticut, and Maine.

Heart-rot (*Trametes pini* (Brot.) Fr.), Maine.

PRIVET.—**Anthracnose** (*Gloeosporium cingulatum* Atk.), Ohio, Oklahoma, Rhode Island, and New York.

RED JUNIPER.—**Rust** (*Gymnosporangium macropus* Lk.), Kansas, Iowa, Missouri, and Nebraska.

RED OAK.—**Nut-rot** (*Sphaeropsis quercina* Cke. & Hk.), District of Columbia.

RED PINE.—**Twig-blight** (*Sphaeropsis* sp.), Wisconsin.

RIVER BIRCH.—**Heart-rot** (*Fomes igniarius* (L.) Gill.), Connecticut.

ROCKY MOUNTAIN MAPLE.—**Leaf-spot** (*Rhytisma punctatum* (Pers.) Fr.), Washington and Oregon.

SASSAFRAS.—**Heart-rot** (*Fomes ribis* (Schum.) Fr.), Missouri. (See Science, n. s., vol. 26, pp. 479–480, 1907.)

SCOTCH PINE.—**Damping-off** in nurseries in Vermont and New York.

Leaf-blight (*Pestalozzia* sp.), Nebraska and Vermont.

SCRUB PINE.—**Rust** (*Cronartium quercuum* Berk.), Maryland, District of Columbia, and Virginia.

SILVER MAPLE.—**Heart-rot**, (*Fomes igniarius* (L.) Fr.), New York.

Leaf-spot (*Rhytisma acerinum* (Pers.) Fr.), New York, Vermont, and Rhode Island.

STRIPED MAPLE.—**Heart-rot** (*Fomes igniarius* (L.) Fr.), Vermont and New York.

SUGAR MAPLE.—**Heart-rot** (*Fomes igniarius* (L.) Gill.), New York; (*Fomes pinicola* (Sw.) Gill.), New York.

Sap-rot (*Fomes fomentarius* (L.) Gill.), New York and Vermont.

SUGAR PINE.—**Sap-rot** (*Fomes pinicola* (Sw.) Gill.), California. **Heart-rot** (*Trametes pini* (Brot.) Fr.), California.

SYCAMORE.—**Anthracnose** (*Gloeosporium nervisequum* (Fckl.) Sacc.), and *Gnomoma veneta* (Sacc. & Speg.) Kleb), serious in the Eastern States and as far west as the Rocky Mountains. Defoliation common east of the Alleghenies. In many localities the disease was complicated by serious frost injury.

WHITE ASH.—**Heart-rot** (*Fomes fraxinophilus* (Pk.) Sacc.), Missouri.

WHITE BIRCH.—**Sap-rot** (*Polyporus betulinus* (Bull.) Fr.), New York and Vermont.

WHITE ELM.—**Leaf-spot** (*Phyllosticta ulmicola* Sacc.), Oklahoma.

Heart-rot (*Fomes igniarius* (L.) Gill.), Maine.

WHITE PINE.—**Damping-off** (*Fusarium* sp.), New York, Vermont, and Iowa.

Leaf-blight associated with *Septoria parasitica* Hartig., Maine, Vermont, New Hampshire, New York, Connecticut, and Pennsylvania; *Pestalozzia* sp., Long Island, Massachusetts, and Vermont.

Root-rot (*Polyporus schweinitzii* Fr.), Maine.

WHITE SPRUCE.—**Heart-rot** (*Trametes pini* (Brot.) Fr.), Vermont and New York.

Sap-rot (*Fomes pinicola* (Sw.) Gill.), New York; (*Lenzites sepiaria* (Wulf.) Fr.), New York, Vermont, and Maine; (*Polystictus abietinus* (Dicks.) Quel.), Maine, New Hampshire, Vermont, New York, and Connecticut.

WILLOW (species undetermined).—**Rust** (*Melampsora* sp.), Delaware, Iowa, and New York.

Black-spot (*Rhytisma salicinum* (Pers.) Fr.), Rhode Island and Oregon.

YELLOW BIRCH.—**Heart-rot** (*Fomes igniarius* (L.) Fr.), Vermont and New York; (*Fomes nigricans* Fr.), New York.

ORNAMENTAL PLANTS.

Diseases of ornamentals were reported as indicated:

ASTER.—**Rust** (*Coleosporium sonchi* (Pers.) Lev.), North Carolina.

Wilt (*Fusarium* sp.), Delaware, Colorado, Massachusetts.

Yellows, Connecticut, Delaware, Massachusetts, Rhode Island, Maryland, and California.

CARNATION.—**Bud-rot** (*Sporotrichum antrophilum* Pk.), New York, Illinois, and Nebraska. (Bul. 103, Nebr. Agr. Expt. Sta.)

Fairy ring disease (*Heterosporium echinulatum* (Berk.) Cke.).

Root-knot (*Heterodera radicicola* (Greef.) Mül.), North Carolina and California.

Rust (*Uromyces carophyllinus* (Schrk.) Schrt.), Rhode Island, Massachusetts, West Virginia, and Nebraska.

Stigmonose, Rhode Island; less prevalent.

CHRYSANTHEMUM.—**Leaf-spot** (*Septoria chrysanthemi* Cav.), Delaware, North Carolina, Nebraska, Massachusetts, and West Virginia.

Rust (*Puccinia chrysanthemi* Roze.), Massachusetts, Rhode Island, and Delaware.

Ray-blight (*Ascochyta chrysanthemi* Stevens), a new disease, occurs in North Carolina and is described by Dr. F. L. Stevens (Bot. Gaz. vol. 44, pp. 241–258).

Powdery mildew (*Oidium chrysanthemi* Rabh.), Nebraska.

DAHLIA.—**Powdery mildew** (*Erysiphe communis* Wallr.), Iowa and California.

HOLLYHOCK.—**Leaf-blight** (*Cercospora althaeina* Sacc.), Delaware and Massachusetts.

Rust (*Puccinia malvacearum* Mont.), West Virginia, Massachusetts, California, New York, Washington, New Jersey, and Colorado.

LILAC.—**Powdery mildew** (*Microsphaera alni* (Wallr.) Salm.), Nebraska, Rhode Island, Delaware, Iowa, and New Jersey.

LOBELIA.—**Root-knot** (*Heterodera radicicola* (Greef.) Mül.), Nebraska.

PEONY.—**Wilt** (*Botrytis peoniae* Oud.), Rhode Island and Massachusetts.

ROSE.—**Crown-gall**, Missouri.

Leaf-blotch (*Actinonema rosae* (Lib.) Fr.), Washington, Florida, Nebraska, Missouri, Maryland, District of Columbia, and Louisiana.

Leaf-spot (*Cercospora rosicola* Pass.), Louisiana and Nebraska.

Root-knot (*Heterodera radicicola* (Greef.) Mül.), Nebraska.

Rust (*Phragmidium subcorticium* (Schrk.) Wint.), Nebraska and New York.

Powdery mildew (*Sphaerotheca pannosa* (Wallr.) Lev.), California and most of the Eastern, Southern, and Central States.

SWEET PEA.—**Anthracnose** (*Gloeosporium* sp.) was very destructive locally in West Virginia and Georgia.

VIOLET.—**Leaf-spots** (*Marsonia violae* (Pass.) Sacc.), Vermont; (*Cercospora violae* Sacc.), Louisiana.

Root-knot (*Heterodera radicicola* (Greef.) Mül.), Rhode Island.

VIRGINIA CREEPER.—**Leaf-spots** (*Cercospora ampelopsidis* Pk.), Nebraska and Delaware

Powdery mildew (*Uncinula necator* (Schw.) Bur.), Nebraska.

GAME PROTECTION IN 1907.

By Henry Oldys, *Assistant, Biological Survey.*

The most noteworthy features of game protection in 1907 were the extension of the hunting license system, the suppression of tusk-hunting operations in the Yellowstone National Park and vicinity, and the introduction of European partridges in many localities for restocking depleted covers. The benefits derived from the adoption of a system of hunting licenses are receiving more general recognition. The success of the resident license as a means of raising revenue for game protection and of establishing mutually advantageous relations between game officials and sportsmen has been so apparent in those States in which it has been introduced that each year witnesses its extension. To a lesser extent the alien license, devised as a means of checking the depredations of aliens of the lower class, is also steadily advancing in favor. The destruction of elk for their teeth or tusks for some years has been making serious inroads on these fine game animals and fruitless efforts have been made to check it. By the apprehension and punishment during the year of two of the ringleaders in this unlawful pursuit the practice has apparently been successfully broken up at its principal place of operation. Losses of quail and ruffed grouse produced a temporary scarcity of upland game birds, and it has been sought to supply the deficiency by the expedient of importing birds from Europe. An encouraging increase in the abundance of quail during the year, however, and the failure in the supply of European partridges have halted these introductions somewhat and it is probable that as native birds regain their normal abundance excessive interest in foreign birds will show some abatement.

LEGISLATION.

The game legislation of 1907 has shown a decided tendency toward providing stricter laws and better means of enforcement. Measures of some sort were under consideration in all the States and Territories except Kentucky, Louisiana, Maryland, Mississippi, Ohio, Oklahoma, and Virginia (where no legislative sessions were held), and in all the Canadian Provinces. Of these measures 180 became laws, including 71 local laws passed in North Carolina. Alabama, Missouri, Texas, and Utah placed entirely new game laws on their statute books. The American Ornithologists' Union's model law giving comprehensive protection to nongame birds was adopted by Alabama, West Virginia, and Utah, and was considered by North Dakota. This law is now in force in all the States east of the Mississippi River except Maryland and in 12 of the remaining 22 States and Territories.

The hunting license system was greatly extended. It was installed for the first time in Alabama, California, Connecticut, Rhode Island, and Texas. Each of the first three of these States established a complete system embracing resident, nonresident, and alien licenses; Texas adopted nonresident and alien licenses, and Rhode Island a nonresident license. Resident licenses were also adopted by Tennessee and Utah; a nonresident license by Massachusetts, and alien licenses by Maine, New Hampshire, and South Carolina. Ineffectual attempts were made to establish resident licenses in Florida, Iowa, New Jersey, New York, and Pennsylvania, an alien license in New Jersey, a satisfactory nonresident license in New York, a $100 nonresident license in North Carolina for shooting on Currituck Sound, and a license for private preserves in Michigan. A hunting license of some kind is now required in all the Provinces of Canada and in all but 7 of the States and Territories.

The warden service was strengthened in Illinois, New York, Montana, and Michigan by increases in the force. Consolidation of various phases of protection under one department was effected in Michigan, Montana, Texas, and Ontario, and attempted without success in Washington; while in California, on the other hand, a futile attempt was made to give game protection to a separate official. Unsuccessful efforts were made in Florida to establish a State warden service and in Montana to abolish the one in force, and Delaware was equally unsuccessful in the attempt to create a State game commission to relieve the Delaware Game Protective Association, which now has charge of game law enforcement.

The growing need of special provision for game preserves and game propagation received recognition in several States. California authorized the State fish commissioners to set aside private lands as State game preserves on their registration for that purpose by the owners; Massachusetts provided for the establishment of a preserve for heath hens on Marthas Vineyard; Minnesota made game and bird preserves of all the State forest reserves, lands, and parks; Pennsylvania placed the State game preserves under rigid restrictions, prohibiting all entry upon them during the hunting season and entry with dogs or firearms at all times; and Alberta established two new Provincial preserves and British Columbia considered a reserve for mountain goats. A bill

for the establishment of a herd of buffalo in the Adirondack Park passed the New York legislature, but was vetoed by the governor. The growth of the industry of raising game for market, like cattle and poultry, is manifested in legislation in Illinois, Indiana, North Carolina, and Vermont exempting from certain restrictions deer raised in confinement. Ten States now have such provisions in their laws, and the production and marketing of domesticated game seems destined to become an industry that will demand more and more recognition in future legislation. With proper means of identification provided, so as to prevent evasions of the laws prohibiting traffic in wild game, there would seem to be no reason why this industry should not be encouraged in every possible way.

The campaign against the automatic gun resulted in the introduction of bills in 17 States and 2 Canadian Provinces to prohibit its use. All of these failed to become laws, however, except in one State—Pennsylvania—and the two Provinces—New Brunswick and Ontario. A few novel features in game protection were introduced, the most noteworthy of which were Alabama's action in making the office of State game commissioner an elective one, and Florida's in requiring in two of its counties a property qualification for hunting. Montana endeavored without success to create the elective office of county game warden.

Among the measures which failed to become laws, in addition to those already mentioned, were a Federal bill to provide a license system in Alaska (which passed the House but failed in the Senate) and several to establish game refuges in National forests, and State bills to abolish spring shooting in New Jersey and North Dakota, to prohibit all sale of game and give adequate protection to woodcock in New Jersey, to exclude firearms from the woods of Maine in close season, to give added protection to antelope in Wyoming, to remove protection from waterfowl in Arkansas, and to open the waterfowl season in spring in Wisconsin.

DECISIONS OF THE COURTS.

A number of important decisions affecting the interpretation of game laws were announced during the year. Several of these relate to the status of domesticated game. The growing tendency to raise deer in confinement for the markets makes it more and more necessary to determine with definiteness how far such deer are subject to game laws. The two most important decisions on this subject were rendered by the supreme courts of Missouri and New York. The Missouri case (State *v.* Weber, 102 S. W., 955) arose from the exposure for sale in Kansas City of the carcasses of 8 deer from which the natural evidence of sex had been removed. These deer had been raised on a stock farm in Henry County, and came from a tame herd that had been in possession of the owner of the farm for twenty-five years. They were not hunted, but were kept in an inclosed pasture and were permitted to run with cattle, receiving the same treatment. The owner was accustomed to kill several every year for sale in the Kansas City market. The defendant was convicted at the January, 1906, term of the Jackson County criminal court for having carcasses of deer in possession which did not have evidence of sex, as required by the Missouri game law. His defense was that the law in question applied only to wild deer. The case was appealed to the Kansas City court of appeals and from there transferred to the supreme court of the State, which upheld the decisions of the lower courts. The court held that the law applies to tame deer as well as wild and decided the further point that this construction does not violate the State constitutional prohibition of taking private property for public uses without compensation.

The New York case (Dieterich *v.* Fargo, 104 N. Y. S., 334) arose through the refusal of the American Express Company to transport deer raised and killed in a private preserve in Dutchess County. To preserve the herd and to prevent the bucks from injuring each other the owner found it necessary to kill a considerable number every year, which were shipped to New York City for sale. On refusal of the express company to accept deer for shipment, Dieterich applied for a temporary injunction pendente lite, claiming that the law prohibiting the transportation of deer from one county to another and requiring express companies to refuse to accept deer for such transportation did not apply to domesticated deer. An adverse decision was rendered at the special term of the supreme court in New York County in December, 1906, and on appeal to the appellate division of the supreme court this decision was sustained May 10, 1907, by a majority of the court, which held that the law in question applies to domesticated as well as wild deer. In view of these decisions States desiring to permit the marketing of domesticated game should make special provision for the same by statutory enactment.

The status of game imported into a State was the subject of several decisions by the New York supreme court—People *v.* Weinstock, 102 N. Y. S., 349; People *v.* Stillman,

102 N. Y. S., 351; and People *v.* Waldorf-Astoria, 103 N. Y. S., 434. In the most important of these, the Waldorf-Astoria case, which came before the supreme court on appeal from the trial term, the question arose upon the possession by a hotel company in New York City of English pheasants raised and killed in a foreign State. The court held that the action of the hotel company was a violation of the law prohibiting the possession of English pheasants and that the law was not unconstitutional as depriving persons of property without due process of law.

The conflicting decisions of 1906 under the Missouri license law were taken to the supreme court of Missouri, which sustained the St. Louis court of appeal in its decision that the law of Missouri does not require a resident of the State to secure a license to hunt in his own county (State *v.* Koock, 100 S. W., 630). The Illinois license law was attacked on constitutional grounds, but the supreme court of the State held that it was constitutional and a reasonable exercise of the police power for the protection of game (Kyle *v.* People, 80 N. E., 1081). The appointment of game wardens by county commissioners in Washington under the laws of 1905 was declared in violation of section 5, article 11 of the State constitution, providing for the election of all county officers (State ex rel. Snodgrass *v.* Savage, 92 Pac., 409)—a decision that would have rendered the entire warden service of the State inoperative but for the expedient of making some of the game wardens deputy sheriffs. In California the court of appeal decision in the second district denying the right of county supervisors to fix close seasons (Ex parte Prindle, 94 Pac., 871), which was rendered on an application for habeas corpus, became final through the supreme court of California, to which the case was ordered to be transferred, holding that such orders of transfer can not be made in habeas corpus cases.

The nongame bird laws of Louisiana and Pennsylvania came before the courts for construction. In the Louisiana case (State *v.* Schwartz, 44 So., 20) the defendant Nathan I. Schwartz, the owner of a large store in New Orleans, had been fined $50 in the first city criminal court for offering 75 aigrettes for sale. This judgment was affirmed by the criminal district court with a slight modification of the penalty, and an application for certiorari and prohibition was refused by the supreme court of the State April 15, 1907, which also, on May 13, 1907, denied a rehearing. The Pennsylvania case, which was decided by a lower court, involved the possession of redbirds, or cardinals, in violation of the State law. The defense that the birds in question were specifically or subspecifically different from the redbirds found in Pennsylvania was proved invalid, and the defendant was fined.

Certain important Federal cases arose through efforts to stop the destruction of elk for their teeth and trophies. William Binkley and Charles Purdy, two members of a well-known gang of tusk hunters, were arrested at Los Angeles, Cal., with a supply of elk trophies which they had secured in and near the Yellowstone National Park and had shipped to California from Idaho. They were arraigned at the April term of the Federal court at Pocatello, Idaho, for violation of the Lacey Act through interstate shipment of game killed in violation of law, pleaded guilty, and were fined $200 each. They were immediately rearrested on the charge of killing elk in the Yellowstone National Park in violation of the Federal act protecting game within the park, and on September 10 were tried before the United States commissioner at Fort Yellowstone. They were found guilty and were sentenced to three months' imprisonment and the payment of costs, which amounted to $933. It may be added that Binkley escaped after a few weeks' imprisonment and is still at large, and that Charles Isobel and Oscar Adams, the other members of the gang, were indicted at Cheyenne, Wyo., on November 11, 1907, on evidence furnished by Purdy, who was sent from Fort Yellowstone as a witness. In the prosecution of these men many difficulties supervened, but as they had flagrantly and openly violated the laws it was realized that a successful prosecution was necessary in order to break up tusk-hunting operations in the park and its vicinity. The result of the convictions has amply justified the time, trouble, and expense incurred in securing them.

ADMINISTRATION AND ENFORCEMENT OF LAWS.

Administration.—Several new offices were established in 1907 and a few changes were made in existing ones. In Alabama the office of State game and fish commissioner was created; in South Carolina the State Audubon Society was incorporated and empowered to act as a State game commission; in Texas the office of fish and oyster commissioner was reorganized to include a chief deputy game commissioner; and in Ontario the office of chief game warden was superseded by that of superintendent of game and fisheries. Changes in personnel included part of the boards of Arizona and California, the State game and fish commissioner of Colorado, the warden and chief deputy of Michigan, the executive agent of the board of game and fish

commissioners of Minnesota, the game and fish wardens of Missouri, the board of fish and game commissioners of New Jersey, the wardens of the two districts of North Dakota, the chief warden of Ohio, the State fish and game commissioner of Utah, and the State warden of Wisconsin.

Enforcement.—Special activity was shown by the game wardens of Oklahoma in attempting to suppress illegal shipments of quail to northern markets, and quail to the number of 30,000 or more were confiscated. In a number of convictions in various States heavy penalties were inflicted for violation of the game laws. In two cases of illegal shipments of game from St. Louis to Chicago fines amounting to $5,175 and $700, respectively, were imposed; the supreme court of New York imposed a fine of $4,250 upon the proprietor of the Café Martin in New York City for illegal possession of quail and ruffed grouse after midnight January 1, 1907; at Calais, Me., a $700 fine was imposed for an attempt to ship deer and moose to Boston; in Fremont County, Colo., $500 and costs were paid for the illegal killing of a mountain sheep; and in Oklahoma one of a party of three, arrested while preparing to export 1,200 quail, paid $500 and costs, while the other two gave bond for trial in January, 1908. In Oklahoma also a $300 fine was paid for the possession of 300 pounds of dressed quail about to be shipped from the State, and $165 in another case for export of quail from the State. For illegally killing moose and having moose meat in possession two offenders in Maine paid $250 each. In Pennsylvania $258.30 was paid for killing 35 robins. A fine of $200 was imposed in Illinois for an attempt to ship quail to market in a trunk marked "baggage," and one of equal amount in Pennsylvania for the killing of 7 ruffed grouse in close season. Each of a party of three in Maine paid $160 and costs for killing 4 deer illegally, and each of a party of three in Montana paid $150 for illegally killing elk. In Illinois a fine and costs amounting to $125 were paid for trapping robins and feeding them to ferrets. Fines of $100, with or without added costs, were imposed in Indiana, Maine, Massachusetts, Minnesota, Montana, Pennsylvania, Vermont, Washington, Wisconsin, and the Yellowstone National Park, for various offenses, such as hunting without license, illegal killing of deer, moose, elk, and partridges, and illegal sale and shipment of game.

CONDITION OF GAME.

The year 1907 was, generally speaking, very satisfactory, so far as the game of the United States is concerned. There were setbacks here and there, owing to usual causes—prevalence of natural enemies, nonobservance of game laws, and adverse climatic conditions; but, with the exception of a marked decrease of ruffed grouse and local scarcity here and there of certain other birds and game, the season was very favorable, and it is probably safe to say that game was more abundant at the end of the year than at the beginning.

BIG GAME.—Deer are increasing everywhere, except in a few restricted sections. In North Carolina and South Carolina, and perhaps a few other States, a decrease in their number has been caused by the prevalence of black tongue, a disease probably identical with what is known as gloss anthrax, a well-known malady affecting stock. Deer are abundant in New Brunswick and Nova Scotia, are rapidly increasing in New England outside of Maine, and in Ontario are in excellent condition. In the deer sections of New York and Pennsylvania a rapid increase is noted, and the deer introduced into New Jersey within the past few years are holding their own well. They are more than usually plentiful in Michigan, and in Wisconsin probably not fewer than 10,000 were killed during the season of 1907. Throughout the West and Southwest they seem to be maintaining their abundance or increasing in number, and they may now be found in Illinois and in Iowa (in the latter case a herd of nearly 200 has developed from 20 that were released from a private preserve a few years ago). With proper care it would seem the United States need have no difficulty in maintaining its fine stock of deer.

The moose of the country also show an increase. They are holding their own in Wyoming and the Yellowstone National Park, increasing in Montana, and probably slightly increasing in Minnesota. They are reported as abundant in New Brunswick and Nova Scotia. Moose are yet to be found in countless numbers in Alaska, though a perceptible diminution is said to have occurred on the Kenai Peninsula, owing to unregulated slaughter for food rather than for the attractive trophies supplied by the largest moose in the world.

Elk are holding their own or increasing in Wyoming, Idaho, and the Yellowstone National Park. In the Adirondacks the original stock of 22 introduced in 1901 has grown to not less than 350, mainly from natural increase, though a few have been added. It is interesting to note that about 50 elk, probably from the Corbin preserve, are now running wild in New Hampshire.

A few caribou inhabit the northern part of Minnesota. There are none in Maine, though the animals are fairly abundant in New Brunswick. They still exist in enormous numbers in Alaska, where an immense herd recently crossed the Yukon River in their periodical migration.

Mountain sheep are increasing in Wyoming and the Yellowstone National Park, and several hundred are still to be found in Idaho. They are increasing also in the Southwest.

There is a slight increase in the number of buffalo in the Yellowstone National Park, where the tame herd now numbers 59 and the wild herd is estimated to contain 25. The Pablo-Allard herd, numbering about 400, is being transferred from Montana to Alberta and will ultimately find a home in Buffalo Park on Battle River, a reserve of 125,000 acres located about 120 miles east of Edmonton. One hundred have already gone to Canada, and it is expected that the remaining 300 will be rounded up and shipped by next August. Fifteen buffalo were successfully transferred from the New York Zoological Park to the Wichita Game Preserve in Oklahoma in October. The long railroad trip and the overland journey to their new quarters were made without a mishap.

In general, antelope have probably decreased in number. They are increasing in Idaho and the Yellowstone National Park; but they have materially decreased in Wyoming, owing to great losses in the Green River herd through severe weather in March. The antelope of Texas are increasing under the absolute protection of the present law.

Game birds.—Quail have had a very good year and are on the road to recovery from the great decrease in their numbers occasioned by the recent occurrence of two successive severe winters. They are reported to be increasing throughout their range, with a few exceptions, chiefly in the northern part. While there are few in Ontario, New England, New York, and New Jersey, they are slowly increasing in Pennsylvania and Maryland, are making fair gains in the Middle States, and show an abundant increase in the South; even from Alabama, Oklahoma, and Texas, which were so heavily drawn on recently for supplies of birds to restock northern and eastern covers, come reports of great abundance. There seems to be little, if any, reason to doubt that, with restraint on the part of sportsmen, the bobwhite will in a few years be as numerous as ever in those localities where it was so nearly exterminated.

The ruffed grouse has undergone a diminution in numbers similar to that shown by the bobwhite two or three years ago, and is very scarce throughout its range, except possibly in the extreme southern part. The sudden passing of this popular game bird from comparative abundance to great scarcity has aroused much interest and called forth many explanations of the phenomenon. The reason that finds most general acceptance is an unfavorable breeding season—a very warm March followed by an exceedingly cold and wet spring. Other factors doubtless contributed to the decrease, their influence being probably augmented by unfavorable climatic conditions. The unusual and excessive diminution of this hardy grouse, following so closely the great destruction of quail, has occasioned much anxiety lest we shall have irretrievably lost two of our chief game birds, and has led to unusual activity in the introduction of foreign birds. But such catastrophes are not new and there is good reason to believe the birds will show the same recuperative powers they have exhibited in the past. Sportsmen are urged to be in no haste to restock game covers with Old World birds. Introduction of exotic species is always a lottery. Expensive failures often result from such experiments, and the introduced birds may develop injurious traits under new conditions, however harmless they may be in their native habitats. It is quite certain that no birds can replace the bobwhite and ruffed grouse in the estimation of American sportsmen, and the former has a well-proved value as a destroyer of noxious insects and weeds. Efforts should rather be directed to the restoration of these two fine American game birds than to the acclimatization of foreign birds, however highly the latter may be valued at home.

Wild turkeys are increasing and in some parts of their range are more numerous than for several years. Prairie chickens still exist in large numbers in different parts of their range, but reports indicate that, taking the range as a whole, there has been a slight decrease in numbers. Woodcock show a gain in many localities, and there seems to have been an increase during the year in the total number of birds. Waterfowl show a marked increase. One of the most encouraging features of the condition of game in 1907 is their unusual abundance. Great flights of ducks and geese were noticeable at many ducking centers of the United States, probably largely as a result of increased protection. Wild fowl are very prolific, and it needs but the enactment and enforcement of judicious laws to greatly augment their numbers.

QUAIL DISEASE.

Special mention should be made of a highly contagious and rapidly fatal disease that has made its appearance among the quail of the United States. The depletion of quail covers of the East caused large transfers of quail from the West and South. It was observed that many of the birds thus shipped arrived dead, or died shortly after arrival. Investigation by the Department disclosed the presence of a disease resembling the grouse disease which appeared in England a century ago and created great havoc in the grouse preserves. As described by Dr. George Byron Morse, of the Bureau of Animal Industry of this Department, the newly discovered malady, which he named *Colibacillosis tetraonidarum*, is "an infectious disease of the grouse family, caused by a microbe of the *Bacillus coli* group, and characterized by congestion of the lungs, focal necroses of the liver, and intestinal ulcerations."[a]

The period of incubation appears to be about ten days. The first symptom is dullness and a tendency to sit in a corner with fluffed feathers. Food is neglected and the bird generally dies in two or three days. Sometimes the disease runs a more chronic course, diarrhea appears, though rarely very marked, and the bird becomes extremely emaciated.

Investigation shows that this disease prevailed among quail at least as long ago as 1905 and perhaps several years earlier. It has been found to have occurred in Alabama, Kansas, and Oklahoma, and at Washington, D. C., Mount Vernon, Va., Elizabeth, Pa., Boston and Worcester, Mass., and Yarmouth, Nova Scotia. The known centers of infection—that is, collecting and distributing points which have been proved to be infected—are Alexander City, Dadeville, and Birmingham, Ala., Wichita, Kans., and Marlow, Okla.

The disease is not confined to the bobwhite (*Colinus virginianus*), but has been found to be transmissible to the California valley quail (*Lophortyx californicus vallicola*), the Gambel quail (*Lophortyx gambeli*), the mountain quail (*Oreortyx pictus*), the scaled quail (*Callipepla squamata*), and the sharp-tailed grouse (*Pediocætes phasianellis campestris*). Hence the greatest care is necessary to avoid danger of a widespread mortality among the gallinaceous game birds of the United States. Fortunately recent laws that prevent unregulated export of quail from several former sources of supply have retarded spread of infection.

No authentic instance is known to the Department of the appearance of the disease among wild quail, but careful watch should be kept and all suspicious cases of mortality among wild quail or other birds of the grouse family should be reported to the Department for prompt and thorough investigation.

RESTOCKING COVERS.

There was much activity during the year in restocking depleted game covers. As different species of game have decreased in numbers in various localities, attention has been given to the introduction of game from other States or from foreign countries. Depleted quail covers in the North and East have been restocked with bobwhite from the West and South and from Mexico, and, to a limited extent, with California or valley quail from California but with indifferent success. The outbreak of disease among captive quail caused large numbers of these imported birds to arrive at their destination dead or to die soon after arrival, and many that escaped disease succumbed to the more rigorous winters of their new habitats. Doubtless the strangeness of the environment lent additional difficulties to the maintenance of the birds.

The problem of providing a normal supply of game being thus left unsolved, and large funds for improvement of hunting conditions having resulted from the general adoption of the resident hunting license system, much attention has been given to foreign game birds. The successful introduction of the Chinese pheasant into Oregon, Washington, and British Columbia was followed with more or less successful attempts to acclimatize this or the English pheasant in other States, until now imported pheasants are on the game list of all but 9 States (of which 5 are in the South) and all the Canadian Provinces except Quebec, Prince Edward Island, and those in the extreme north. While in some States the law protecting introduced pheasants is an empty form, the subject of such protection having long since disappeared, in others it is in active operation, as the birds are well established and are increasing steadily. Among the States in which the latter condition prevails may be mentioned Massachusetts, New York, Ohio, Illinois, and Colorado. In 1907 attention was chiefly directed to the introduction of the European partridge, obtained usually from Hungary. Illinois,

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[a] Quail Disease in the United States, Circular 109 Bureau of Animal Industry, U. S. Department of Agriculture, p. 3.

Kansas, and Michigan are prominent among the States in which restocking with this bird has received the greatest attention, and thousands of European partridges are now to be found in the game coverts of the United States. The number would have been much larger but for the shortage in the supply caused by a wet fall in Hungary which made Hungarian partridges scarce. The price increased to $6 per pair delivered in London, and birds were hard to secure even at this rate, which is 30 to 50 per cent higher than the normal price. The expediency of devoting funds and attention more largely to the introduction of exotic pheasants and partridges than to the rehabilitation of our native game birds has already been discussed under the head of "Condition of Game."

As an example of the progress made in transporting large game birds, it is noteworthy that 23 capercailzie and 22 black game were shipped from Denmark to Newfoundland in the fall of 1907 and subsequently transferred to the Peninsula of Avalon without the loss of a single bird.

IMPORTATION OF WILD ANIMALS AND BIRDS.

The most important feature of the importations of the year was the interest shown in the introduction of European partridges, of which 5,205 were imported as against 2,644 of the previous year, chiefly because of the scarcity of native game birds in some localities. Pheasants of all kinds to the number of 4,966 were imported, an increase of 1,194 over the entries of the previous year. Many of these were fancy stock for aviaries, but the importations included 1,831 English and Chinese pheasants secured mainly for liberation. In considering these figures as indicative of restocking operations allowance must be made for the fact that many more pheasants than partridges are raised in this country. It is interesting to note that 24 true Mongolian pheasants (*Phasianus mongolicus*), a species of which 3 specimens were brought in in 1906 (the second time the species had ever entered the United States), were imported during the year. The increasing demand for these pheasants is due to the fact that in England it has been found advantageous to cross the ringneck with the Mongolian pheasant, and some American game preservers are anxious to try the effect of this cross. Other game birds imported in 1907 were 56 ruffed grouse from Canada, 29 capercailzie and 23 black game from Denmark, 2 ocellated turkeys from Mexico, 2 rare curassows from Yucatan (*Crax chapmani*—the first importation into this country of this species, of which only 1 specimen had ever previously been secured), 8 willow grouse, 6 Canada grouse, 512 quail, 541 ducks, 64 geese, and 8 miscellaneous game birds, a total of 11,422 game birds, as against 9,774 in 1906.

The importation of cage birds continues to increase. The number of canaries entered in 1907 was 352,564, an increase of 25,574 over the importations of the previous year; and miscellaneous cage birds were brought in to the number of 47,816, an increase of 3,256. The mammals imported during the year numbered 791, an increase of 302.

The number of eggs of game birds imported for propagation showed only a slight increase, 5,790 in 1907 as compared with 5,604 in 1906; but a wider interest in this method of restocking covers was indicated by the fact that these were imported by 20 different parties, while 5,500 of the number brought in last year went to the State game farm of Illinois. Of the eggs imported in 1907, 4,840 were pheasant eggs, and the remaining 950 were eggs of partridges.

NATIONAL PARKS, REFUGES, AND RESERVATIONS.

Seven new bird reservations were established in 1907, three in the Gulf of Mexico and four on the Pacific Coast, as follows: Tern Island Reservation at the mouth of the Mississippi River, August 8; Shell Keys Reservation off the coast of Louisiana, August 17; Three-Arch Rocks Reservation off the coast of Oregon, October 14; Quillayute Needles, Copalis Rock, and Flattery Rocks reservations off the coast of Washington, October 23; and East Timbalier Island Reservation off the coast of Louisiana, December 7. The islands comprising these reservations are useless for agricultural purposes, consisting of "mud lumps," reefs, and small rocky islets, and are tenanted by large numbers of gulls, terns, pelicans, murres, cormorants, petrels, puffins, and other sea birds. A few small groups of sea lions make their homes on the Washington islands.

Birds continue to increase on the reservations already set apart. On Pelican Island the pelicans returned to the number of 5,000 about the middle of October, 1906, after an absence of one month. They began nesting about the first of November and raised a brood of 2,000 young. Nesting was then resumed, but on the second of April the island was swept by high water, the result of a fierce storm, and the second brood, numbering 600 birds, was entirely destroyed. Instead of leaving the island the pelicans began nesting a third time, and by June 1 had 100 nests with eggs and young, About

a week or two later, however, they abandoned their broods and at the end of June left the island on their usual migration. On Stump Lake Reservation there was some poaching during the fall of 1906. Three of the poachers were arrested, were indicted at the May term of court at Fargo, pleaded guilty, and paid their fines. No trouble of this kind has since been reported.

In the Yellowstone National Park, as shown by the report of the superintendent, antelope are increasing and now number about 2,000. Mountain sheep, deer, and possibly moose are also increasing. It is estimated that there are now 200 mountain sheep in the park, 100 white-tail deer, 1,000 black-tail deer, and 25,000 elk. Ducks of several species and large numbers of Canada geese nested and raised broods in the park, and one small island in Yellowstone Lake is occupied entirely by pelicans and gulls. There is every reason to believe that these birds will largely increase in the future and prove an attractive feature to visitors. A determined effort was made by the superintendent to break up poaching, which has been practiced persistently, and 11 offenders were tried, convicted, and heavily fined or placed in the guardhouse at Fort Yellowstone during the fall and early winter of 1907. This prompt and vigorous action doubtless will exercise a strongly deterrent influence.

REVIEW OF ROAD LAWS ENACTED IN 1907.

Compiled in the Office of Public Roads.

There were enacted in the interest of better roads during the year 1907 about 270 separate laws, in 35 States. A great majority of these acts are local in character, some of them are simply intended to strengthen or correct defects in existing statutes, but many of them are of great importance and will undoubtedly have a marked effect on road improvement.

The idea that the State should aid in the improvement of highways is still gaining ground. During the year State-aid laws were adopted by Missouri, Washington, Idaho, and Tennessee, and preliminary investigations have been inaugurated in West Virginia and Wisconsin looking to the adoption of the State-aid plan. Constitutional amendments providing for State aid will be submitted to the people of Wisconsin and Minnesota at the next election. Appropriations to actually build State roads were made in Colorado, Idaho, Utah, and Washington, and State convicts are to be used in building roads in Colorado, Kansas, and Washington.

Bonds are to be issued by the States of Massachusetts and Connecticut to raise money with which to aid towns in building roads. Counties or townships in Illinois, Michigan, Texas, California, New Jersey, Tennessee, and Florida have been authorized, under certain limitations, to issue bonds for road purposes.

Rates of taxation for roads have been increased in Arizona and New Mexico, and the cash tax system has been adopted in South Dakota. The importance of having all road work done under the direction of trained road builders has been recognized in Missouri and in Minnesota by the adoption of appropriate legislation. Arkansas has taken a step in the right direction by authorizing the contract system of working the roads, and Florida has, by suitable legislation, recognized the importance of having the cities and towns aid in improving the roads leading into them. Legislation intended to stimulate the use of the split-log drag was adopted in Illinois, Indiana, Kansas, and Nebraska.

To present all these laws in detail in a brief paper would be impossible, but an attempt has been made in the following paragraphs to give an outline of the most important measures.

ALABAMA.—An act approved March 6, 1907, authorizes the court of county commissioners or board of revenue of any county to levy special taxes for road purposes. The court is also authorized to transfer from the county treasury to the road fund any surplus not needed for general county purposes.

ARKANSAS.—In counties where road funds are raised by taxation, the working of roads may be let by contract. (1907, ch. 273.) A county road commissioner must be appointed and paid a reasonable salary in all counties adopting the contract system, and the county judge may appoint road overseers and pay them out of the county road fund. Roads are laid off and classified according to their importance by the county road commissioner, who also prepares plans and specifications for bridges, for graveling, and for such other improvements as may be necessary. Contracts are awarded by the county judge and county road commissioner. The condition of all roads maintained by contract is reported quarterly to the county judge, who is authorized to withhold payment if roads are not built and maintained according to contract. Under this system all those who are required to work four days each

year on the public roads must work for the contractor four days annually, or pay him $4. This labor or its equivalent in cash becomes part of the contractor's compensation.

Road improvement districts may be formed by the county court (1907, ch. 144), provided the same is petitioned for by a majority in value of the land owners of a county or a part of a county. The road affairs of such improvement district are managed by three directors elected by the land owners. The term of office is fixed at six years, one director being elected every two years. They are vested with authority to construct and maintain by contract or otherwise all roads in their district, and to expend on this work not to exceed 25 per cent of the value of the property in the district. They are also authorized to issue bonds to an amount not exceeding 20 per cent of the value of the property, which bonds may bear interest at the rate of not to exceed 8 per cent and mature within thirty years. The county treasurer is made the custodian of the funds and is allowed one-half of 1 per cent for receiving and disbursing the same. General county revenues and special road taxes may be used by the county court to supplement the funds provided by the improvement districts. This law only applies to 38 out of the 75 counties in the State.

ARIZONA.—The maximum rate at which taxes may be levied for road purposes was increased from 25 to 50 cents on each $100 worth of property. (1907, ch. 95.) Where road warrants are outstanding, the rate must not exceed 60 cents on each $100, instead of 50 cents as heretofore.

CALIFORNIA.—The boards of supervisors are empowered, unless objection is made by a majority of the land owners, to establish road improvement districts, and to grade, gravel, macadamize, oil, or otherwise improve roads, streets, or boulevards outside of incorporated cities or towns. (1907, ch. 442.) Bonds may be issued for this purpose to extend twenty years and to bear not to exceed 7 per cent interest. The bonds are to be paid out of funds secured partly from county funds and partly from a special tax levied for the purpose on all property in the districts. This work is to be done by contract. The boards of supervisors are authorized to employ a civil engineer who is to prepare plans, specifications, and estimates for the work. A "superintendent of work" may also be appointed, who is to receive a salary of $5 per diem.

COLORADO.—The use of State convicts is authorized (1907, ch. 206) in the building of a State road from Trinidad, in the southern part of the State, to Fort Collins, in the northern part. This road is to be run through Pueblo, Colorado Springs, and Denver. It is to connect on the New Mexico line with the old "Santa Fe Trail" at the northern end of what is known as "El Camino Real." This road is to be built under the direction of the board of commissioners of the State penitentiary and according to plans and specifications of the State engineer. The salary of the State engineer and his assistants and the cost of all bridge materials are to be paid by the counties in which the work is done. An appropriation of $10,000 is made to pay for guards, foremen, tools, machinery, supplies, and transportation.

An appropriation of $15,000 is made out of the internal improvement fund to construct a road from Denver to Platte Canyon (1907, ch. 4). It is to be built by contract under the direction of a board composed of the governor, State engineer, the mayor of Denver, the city engineer of the city and county of Denver.

Properly organized road districts are made bodies corporate, and the office of road overseer is abolished in counties so organized (1907, ch. 215). The county commissioners are authorized to appoint a superintendent of roads and bridges who may receive not to exceed $5 per diem, and who is to have charge of the construction and maintenance of bridges and such roads as come under the supervision of the commissioners. Upon petition of a majority of the qualified electors, county commissioners may organize any county into road districts. Three directors are elected by popular vote for each district every two years, who have charge of all roads and bridges, except those under the jurisdiction of county commissioners, and who may make contracts for work or materials. In counties so organized into districts, the county commissioners may levy a property tax for road purposes of not to exceed 50 cents on each $100 of assessed valuation. Every able-bodied man in each district between 21 and 50 years of age is required to pay $3 or work two days annually upon the public roads. The county commissioners are given sole power to establish new roads.

CONNECTICUT.—An appropriation of $4,500,000 was made (1907, ch. 923) for the purpose of aiding in the improvement of the public roads under the State aid law. This money is to be expended under the direction of the State highway commissioner during the six fiscal years ending October, 1913, at the rate of not to exceed $750,000 per annum. To provide funds necessary for this purpose, the State treas-

urer is authorized to issue bonds which are to be paid in twenty-two annual installments, and are to bear interest at the rate of 3½ per cent.

The salary of the State highway commissioner is increased from $3,000 to $5,000 per annum and his allowance for office expenses is increased from $6,000 to $8,000 per annum (1907, ch. 188). An appropriation of $29,000 was made for the salary, traveling and office expenses of the highway commissioner; $50,000 for pay of engineers, deputies, and inspectors; $5,000 for the operation and maintenance of State crushing plants; $50,000 for making repairs to public roads (1907, ch. 485).

The State aid law was so amended as to increase the proportion paid to the towns by the State toward the construction of State-aid roads (1907, ch. 264). Heretofore the State paid two-thirds of the cost in towns having a taxable valuation of over a million dollars, and three-fourths of the cost in towns having a taxable valuation of a million dollars or less. The new law provides that the State pay three-fourths of the cost in towns having a taxable valuation of over a million and a quarter dollars, and seven-eighths of the cost in towns having a taxable valuation of a million and a quarter dollars or less. Heretofore all contracts for State aid roads were let by the selectmen of the towns, but the new law provides that such contracts be let by the State highway commissioner. He is also authorized to improve roads in any town in the State in order to connect up trunk-line systems now under construction, the town's proportion of the cost of such roads being deducted from any subsequent appropriation. Heretofore the towns have been required to keep all State aid roads in repair, but the new law provides that the State highway commissioner shall keep them in repair, the State paying three-fourths and the towns one-fourth of the cost of such work. The sum of $25,000 is set aside annually to meet the State's share in this work.

FLORIDA.—In counties which are not operating under special laws, the rate of levy which may be assessed against all taxable property for road purposes has been increased from 3 to 5 mills on each $100 worth of property (1907, ch. 5677). One-half the amount so assessed against property in incorporated cities and towns must be used for the construction and repair of streets. All able-bodied male residents between the ages of 21 and 45 who do not pay taxes on real or personal property are required to work five days each year on the public roads, or pay $1 for each of the five days they do not work. Counties are authorized to issue bonds for road purposes.

GEORGIA.—Any person may be exempt from the four days' road duty required by law by paying to the road overseer $3 or such amount as the road overseer shall fix as being equivalent to four days' labor (1907, p. 99).

Special road laws were enacted for the counties of Ben Hill, Chatham, Franklin, Greene, and Gwinnett. These acts create and abolish boards of commissioners, establish methods of administration, provide for the collection and expenditure of road funds and for the use of convict labor on the roads. Fulton County was authorized to issue $300,000 worth of bonds for road purposes.

IDAHO.—An appropriation of $5,000 was made to complete the Atlanta road in Ada, Boise, and Elmore counties, provided an equal amount is contributed by subscription or otherwise (1907, ch. 169). This road was begun under an act passed in 1905, the construction being under the Intermountain Wagon Road Commission. It is to be completed by a commission composed of the governor, the State engineer, and the State mining inspector. Twenty-year 4-per-cent State bonds are to be issued for this purpose. The principal and interest are provided for by a three-eighths of a mill tax on each $100 worth of property in the State.

An appropriation of $10,000 was made to aid in the improvement of the Elk City-Dixie road, the Elk City-Oro Grande road, for the building of bridges on these roads, for the purchase of the Kooskia and Tahe toll roads, and for the construction of a trail from Kelly Mountain to the mouth of Bear Creek, all in Idaho County (1907, ch. 129). A sum equal to the amount appropriated by the State is to be raised for this purpose by local subscription or otherwise. The work is to be done by contract by a commission composed of the State engineer, one commissioner of Idaho County appointed by the governor, and one appointed by the board of county commissioners of Idaho County. The county commissioners are paid $5 per day for their services. State bonds are to be issued for this purpose and paid in the same manner as indicated in the preceding paragraph.

An appropriation of $3,000 was made to construct a road from Meadows, in Washington County, to Payette Lakes in Boise County, providing an equal amount is raised by Washington or Boise County or by private subscription (1907, ch. 117). This road is to be built by contract and by a commission composed of the State engineer and one commissioner from each of the counties of Boise and Washington, who are to receive $5 per day for their services. Bonds are to be issued and paid in the same manner as

indicated above. County commissioners are authorized to grant licenses to companies or individuals for the construction and maintenance of roads on which tolls may be collected (1907, ch. 186).

The governor, the State engineer, and the State mining inspector are constituted a "State highway commission" (1907, ch. 173), which is to have charge of all roads, bridges, and trails constructed in whole or in part by the State. Where county commissioners fail to repair such roads, the State highway commission may after thirty days' notice lease the same to some company or individual and permit the collection of such tolls as may be necessary to keep the same in repair.

Each county commissioner is required to inspect all roads in the district from which he was elected at least once a year (1907, ch.177). He shall require road overseers to maintain roads in good repair, and it is made the duty of road overseers to report quarterly to the county board the condition of all roads, the quality and quantity of materials used, the money expended, and the money needed for the ensuing quarter.

ILLINOIS.—The law of 1883 relating to stone and gravel roads is so amended (paragraph 4A, laws of 1907) as to provide that townships and districts may borrow not to exceed $35,000 for the building of hard roads, provided the same is agreed to by a majority of the legal voters. These bonds may extend over a period of ten years. The interest shall not exceed 5 per cent annually and the principal is provided for by taxation.

In counties not under township organization the compensation of highway commissioners is increased (1907, p. 504) from $1.50 to $2 per day, and they are required to keep all roads and bridges in their respective districts in proper repair, and in case they neglect to do so, they are to be held personally responsible for all damages to persons or property caused by such neglect. Roads may be dragged with the split-log drag in such a manner that the water will drain toward both sides. Highway commissioners who fail to keep roads in proper repair may be fined not less than $50 nor more than $200. In counties under township organization the compensation of overseers of highways is increased from $1.25 to $2 per diem (1907, p. 508).

INDIANA.—The boards of county commissioners are authorized (1907, ch. 45) to require the use of friction brakes on all vehicles. The use of deadlocks is made a misdemeanor and is punishable by a fine of not to exceed $20 for each offense. An act approved March 9, 1907, amends chapter 180 by providing that the cost of repairing bridges and culverts on rural free delivery roads may be paid for out of any funds in the county treasury. County or township road officials may be fined not less than $1 nor more than $25 for each day any rural free delivery road under their jurisdiction remains out of repair.

Township trustees are required to divide townships into four road districts (1907, ch. 210), but if the township exceeds 36 square miles, it shall be divided into six districts. The division is made so that each will contain approximately the same number of miles of road, not including streets in incorporated cities and towns. A road supervisor is to be elected for each district in December of each year. He is to construct and maintain roads and bridges according to the direction of the township trustees, using in connection therewith the labor of all those required to work the roads. Roads are to be dragged whenever their condition makes it advisable. The supervisor is to receive $2 per day for his services.

Section 90 of the act of 1905 is so amended (1907, ch. 132) as to provide that in counties having less than 50 miles of gravel roads maintained under county commissioners, the annual levy for the maintenance of the same shall not exceed 3 mills on each $100 for every 10 miles of road, instead of 10 mills on each $100 as heretofore authorized.

IOWA.—Boards of county supervisors of counties located on the State line are authorized to cooperate with road authorities of the counties of adjacent States in the construction and maintenance of roads on the State line (1907, ch. 69).

KANSAS.—Township boards are authorized to have roads kept in repair by the use of the split-log drag (1907, ch. 289). Fifty cents per mile may be paid for each dragging or $5 per mile per annum. In choice of persons to do the work, occupants of land abutting the road are given the preference.

All section lines in the counties of Rice, Greenwood, Chase, Howard, Morris, and Reno are declared public roads (1907, ch. 290). All section lines in the counties of Ellis, Phillips, and Decatur are declared public roads to a width of 60 feet (1907, ch. 91).

The board of directors of the Kansas State Penitentiary are authorized to pave with brick the Kansas City road from the State Penitentiary to the southern limits of

Leavenworth, and to pay for the same by sale of brick manufactured at the penitentiary (1907, ch. 299).

A State road is established between Hay City, Ellis County, and Fort Hays Military Reservation (1907, ch. 296).

MAINE.—The State-aid law was amended by the creation of a State highway department (1907, ch. 112). The State commissioner of highways is to be appointed by the governor and must be a civil engineer. He is to serve four years and receive a salary of $2,500 per annum and actual traveling expenses. An assistant commissioner is provided for, who must be an experienced road builder and civil engineer, and who is to receive $1,500 per annum and actual traveling expenses.

Towns and other subdivisions of the State are required to set apart each year a certain amount of the road funds for the permanent improvement of the highways under the advice of the State commissioners of highways, the amount to be so set apart varying in certain proportions depending upon the taxable valuation. For every dollar so set apart by the towns or other subdivisions the State will give from 75 cents to $2, depending also on the taxable valuation. Where the taxable valuation is less than $100,000 the State will give $2 for every dollar locally raised; where it is between $100,000 and $200,000 the State will give $1.50; where it is between $250,000 and $500,000 the State will give $1.25; and where it is between $500,000 and $1,000,000 the State will give 75 cents for every dollar locally raised. On all work requiring the expenditure of a thousand dollars or more of the joint funds, surveys, plans, specifications, and estimates are prepared by the State highway commission, and the work is let by contract to the lowest responsible bidder. Contracts may be awarded to towns as to individuals. The State commissioner of highways may appoint inspectors to see that the work is done according to specifications. If less than $1,000 is to be expended the work may be done by the selectmen or other officers under the superintendence of the State highway commission. In order to raise money to pay the State's share of the cost of this work, a tax of one-third of a mill on each $1 of valuation is assessed annually on all property in the State. Any balance remaining unexpended at the end of any year may be added to the fund for the next year. After providing for the payment of all State aid applied for during any year, the balance may be expended by the State highway commission in the construction of connecting roads so as to form a continuous system of State roads.

MASSACHUSETTS.—An appropriation of $2,500,000 was made (1907, ch. 446) for State aid to be expended during the years 1908–1912. Not more than $500,000 is to be expended in any one year. Any unexpended balance may be used in the succeeding year. For the purpose of raising this money the issue of $2,500,000 in scrip or certificates of indebtedness is authorized, which is to bear interest at a rate not exceeding 4 per cent annually and to extend over a period not to exceed thirty years. The interest and principal are to be paid out of a sinking fund provided for the purpose, the money being annually raised by taxation in the same manner as other State taxes are assessed and collected.

The construction and maintenance of highways running through two or more cities and towns may be paid for by the cities and towns in such a manner as they may agree upon (1907, ch. 196).

MICHIGAN.—An act approved May 22, 1907, repealed several former acts relating to highway taxation and provided among other things for the levying of a road-repair tax and a highway-improvement tax. The road-repair tax is to be used for repairs only and is assessed on all property in the township outside of incorporated cities and towns and must not exceed 50 cents on each $100 worth of property. The highway-improvement tax is to be used for permanent improvements only, is assessed on all property, including cities and towns, and must not exceed 50 cents on each $100 worth of property. The rates of taxation are fixed by the electors at the annual township meeting. Commissioners of townships are required to report annually to the township boards amounts collected and expended, improvements made, estimates for the ensuing year, and recommendations concerning permanent improvements. The annual township meeting elects a road overseer who is to serve under the township highway commissioner. The township highway commissioner receives a compensation of from $3 to $4 per day and the overseer from $1.50 to $2.50 per day, their compensation being fixed by the township meeting.

An act approved March 26, 1907, repealed the wide-tire law.

Upon application of 25 legal voters, township boards may call elections for issuance of bonds (1907, p. 49). Bond issues must be agreed to by 60 per cent of all those voting. The value of such bonds must not exceed 5 per cent of the assessed valuation

of property and must be expended for permanent improvements only. They may bear interest at the rate of 5 per cent and extend over a period of twenty-five years.

The law providing for county and township systems of roads was so amended (1907, p. 97) as to provide that the new county road system may be submitted to the people for rejection or approval by the county board of supervisors. In counties adopting this system three county road commissioners are elected by the people, one each year for a term of three years. County commissioners are authorized to fix the tax for county roads at not to exceed 2 mills on each $1 worth of property. Counties adopting this system may issue bonds to an amount not to exceed 3 per cent of the valuation of property (1907, p. 221).

Two or more townships, one or more villages, and one or more townships, and one or more cities may organize into a road improvement district and operate under the county road law (1907, p. 39), provided the same is agreed to by a majority of the legal voters.

MINNESOTA.—An amendment to the State constitution was proposed (1907, ch. 478) which provides that the aid of the State be extended in improving public roads and that a tax of not to exceed 0.5 mill on the dollar be assessed on all property in the State to raise the money for this purpose. The amendment is to be submitted to the people at the next regular election.

A joint resolution was approved April 23, 1907, in favor of National aid in the permanent improvement of public highways. The Congress of the United States was requested to authorize the loan of public money for road improvement in such sums and under such conditions as may be deemed advisable.

Each county board is authorized (1907, ch. 458) to appoint and fix the compensation of a competent county surveyor and road builder, whose duty shall be to lay out, survey, and superintend the construction and maintenance of all roads and bridges. The present county surveyor may, if qualified, be appointed to this position. The office of road overseer is abolished, but the town board is authorized to appoint a competent road builder as road inspector, who is to have charge, under the direction of the county superintendent of highways, of the construction and repair of all the town roads and bridges. He shall hold office during the pleasure of the town board and may with the consent of the board appoint one or more competent assistants.

MISSOURI.—An act approved March 30, 1907, established a State road fund, out of which to pay one-half the cost of permanently improving roads, the other half to be raised by the county, districts, or citizens interested. Expenditures are to be made in the several counties in proportion to the assessed valuation of property, but no State-aid money is to be used to purchase rights of way or to pay damages.

An act approved March 8, 1907, provides that a complete record be made of every sale of stock or bonds of any corporation—cotton, petroleum, grain, provisions, or other commodities—on margins or otherwise, and that the seller be required to place a stamp valued at 25 cents on each transaction. The stamps are provided by the State auditor, and all moneys derived from their sale are set apart for road purposes and are distributed among the various counties in the same proportion as the school funds are now distributed. The constitutionality of this act is now being tested by the courts.

On March 30, 1907, an act was approved amending the former law in reference to the tax levied on dramshops. The amended law provides that a tax of not less than $100 nor more than $200 be levied on dramshops for State purposes, and that not less than $250 nor more than $400 be levied for county purposes, the amount to be fixed by the county court levying the tax. The county court is authorized to use two-thirds of the county tax on dramshops for road purposes and to expend the same in the various districts in proportion to road mileage. The court may, however, at its discretion, expend all the money in one or more districts. In Jackson County, of which Kansas City is the county seat, the county court is required to use as much of the county dramshop fund as may be necessary for the maintenance of all macadamized roads in the county. In counties having a population of 50,000 or less, the county courts may at their discretion have the power to use such fund as a road and bridge fund, the money to be expended on the most important roads under the supervision of the road overseer of the district.

An act approved March 19, 1907, provides for the appointment of a State highway engineer, who shall be a competent civil engineer, and who shall have a practical and scientific knowledge of road building. He is to be appointed by the State board of agriculture for a term of four years and is to receive a salary of $2,400 per annum and actual traveling expenses. Deputy highway engineers having the same qualifications as the State engineer may be appointed and their salaries fixed by the State board of agriculture. The State highway engineer and his deputies are subject to the orders of the State board of agriculture, which board is to compile, collate, and publish information secured by the State highway engineer and his assistants. The State engineer is authorized to investigate road conditions and materials throughout the

State, and to devise the best plans and methods of building roads and bridges and to give advice, specifications, and estimates regarding the same to road officials. An appropriation of $12,000 is made to pay the salary and expenses of the State highway engineer and his assistants.

On March 15, 1907, an act was approved providing that each county court appoint a county highway engineer who shall have practical knowledge of civil engineering, bridge building, and road construction. He is to serve for two years and receive a salary of not less than $300 nor more than $2,000 per annum. He is required to devote his entire time to the work, and is not allowed to engage in other occupations. The county surveyor may be appointed to this position, if qualified, but he is not to receive additional compensation, except such fees as are provided for by law. The county highway engineer is to have the supervision of all public roads, bridges, culverts, machinery, and tools in his county. He is to examine and approve all warrants before they are paid by the county commissioners, and is required to inspect roads, bridges, and culverts as often as possible and to see that the same are kept in good condition. The county court may require him to make from time to time a report concerning the condition of the roads, the amount of funds available for each district, together with his recommendations. He is also required to furnish the State highway engineer with such information as may be requested from time to time. He is required to instruct all road overseers once a year at the county seat respecting the best methods of working the roads and of collecting and expending district road funds. Road overseers are required to follow such instructions. A map showing all county and township roads, accompanied by recommendations as to improvement needed, is to be prepared and submitted to the county court in January of each year by the county highway engineer. The construction and maintenance of roads and bridges may be contracted for by the county court, the work to be done according to specifications and under the supervision of the county highway engineer.

In an act approved March 20, 1907, a number of previous laws regarding local taxation and matters of administration are repealed and new provisions enacted. Under this act the county courts or township boards are required to appoint a road overseer for each district, who is to receive a salary of not less than $2 nor more than $3 per day. A road poll tax of not less than $2 nor more than $4 per annum is to be assessed by the county court or township board on all able-bodied citizens of certain ages outside of cities and towns. This tax may be worked out at the rate of $1 per day. The county courts or township boards may also levy a road tax on all real and personal property of not more than 20 cents on each $100 worth of property. Road officials may enter land adjacent to the road for the purpose of opening and maintaining drains or procuring materials, but reasonable compensation may be allowed for damages or for materials taken.

An act approved March 19 provides that road overseers may require roads to be kept in repair by the use of the split-log drag and that they may pay not to exceed 50 cents per mile for dragging the road four times or twice each way, and not to exceed $5 per mile per annum, except on rural free delivery roads, where not to exceed $10 per mile per annum may be paid. In choosing persons to do this work preference is given to occupants of land abutting on the road. Road overseers are required to set aside not less than 10 per cent of all road funds received to be used as an emergency fund in dragging rural free delivery roads.

An act approved March 21, 1907, provides that when incorporated cities, towns, and villages fail to elect officers to maintain a municipal government, such municipality may be made a part of an adjacent road district, and taxes may be levied on such cities and towns, and the streets and roads constructed and maintained in the same manner as in other districts.

An act approved March 19, 1907, provides that upon petition of 100 taxpayers an election may be called by the county court to decide whether bonds may be issued for constructing and maintaining roads or bridges. Two-thirds of the qualified voters of the county must vote for such indebtedness before the bonds can be issued. The bonds may bear interest at not to exceed 5 per cent and shall be free from taxation. They must mature within twenty years, and the interest and one-twentieth of the principal must be paid each year out of a fund raised for the purpose by taxation. All work done under this act must be constructed according to plans and specifications prepared by an engineer employed for the purpose by the county court. The county court is authorized to direct the county surveyor to superintend the construction, and see that the work is done according to contract. Under the new law these duties will probably devolve upon the county highway engineer.

MONTANA.—The sum of $5,760.90, which was received from the United States Treasurer for forest reserves, was distributed among the various counties (1907, ch. 127); one-half of this is to be used for the improvement and maintenance of roads and the other

half for schools. This money was turned over to the State by the Secretary of the United States Treasury in pursuance of a clause in the agricultural appropriation bill of 1906, which provided that 10 per cent of all money hereafter received from each forest reserve be turned over to the State in which the reserve is located, to be expended as above indicated.

NEBRASKA.—Road overseers are authorized to maintain roads by the use of split-log drags, such work to be done by contract or otherwise (1907, ch. 112). The forest reserve fund, referred to in the preceding paragraph, is to be apportioned among the counties in proportion to the area of forest reserves in those counties.

NEVADA.—Special laws were passed for Humboldt (1907, p. 139) and Elko (1907, p. 141) counties, providing for the appointment of a county road supervisor and fixing the compensation of road laborers.

NEW HAMPSHIRE.—The State-aid law was so amended (1907, ch. 60) as to provide that all State-aid road work be done according to specifications furnished by the governor and council, and that where the amount to be expended for this purpose exceeds $1,000 the work shall be done by contract. The governor and council may let such contracts to the authorities of the town or city in which the road is located, provided they are prepared to do the work satisfactorily. The governor and council are authorized to purchase land on which road materials are found, the same to be paid for out of the State-aid fund. Materials so secured may be sold to cities and towns at reasonable prices.

NEW JERSEY.—A joint resolution (No. 2) was passed, which provides for the appointment of a nonpaid commission composed of five persons to investigate the high price of stone and the increased cost of stone roads, the advisability of the State owning and operating its own crushing plants, and the cost of purchasing quarries and suitable machinery. An appropriation of $1,000 to pay clerk hire and other expenses was made. The commission is authorized to report its findings and recommendations to the governor on January 1, 1908.

Thirty-year 4-per-cent bonds may be issued for the repair of roads, avenues, and streets in towns, townships, or boroughs, provided the cost of making the original improvement was paid for by an assessment on the property specifically benefited, and provided further that the bond issue is agreed to by a majority of the legal voters (1907, ch. 115).

NEW MEXICO.—Boards of county commissioners are authorized to divide their counties into not more than three road districts and to appoint a road overseer for each, whose compensation shall not exceed $3 per day (1907, ch. 53). The rate of taxation for road purposes may be increased from 2 mills to 3 mills on each dollar's worth of taxable property and every able-bodied man between 21 and 60 years of age is required to pay a road tax of $3, or work three days on the road. The old law required them to work from three to five days or pay $1 for each of the days they did not work.

NEW YORK.—Paragraph 53, chapter 568, of the law of 1890 was amended (1907, ch. 116) by establishing a new basis under which State aid is extended for repairs to the towns which have adopted the money system. Heretofore the State paid 50 cents for every dollar in cash locally raised for the repair of roads in the money-system towns, but hereafter the aid given will be based on the assessed valuation of property per mile of highway not including cities and towns. For every dollar locally raised in cash and where the valuation is $5,000 or less per mile of road, the State will pay $1; when the valuation is from $5,000 to $7,000, 90 cents; from $7,000 to $9,000, 80 cents; from $9,000 to $11,000, 70 cents; from $11,000 to $13,000, 60 cents; from $13,000 upward, 50 cents; but in no case will the State pay more than $25 for each mile of road in a town, except where the valuation exceeds $25,000 per mile of road, when the State's share shall not exceed 0.1 per cent of the assessed valuation of property. Under this sliding-scale arrangement it will be observed that the poorer towns will receive a greater proportion of aid from the State than the richer ones. An appropriation of $730,000 was made (1907, ch. 336) for paying the State's proportion of the cost for the repair of highways pursuant to the above arrangement.

Appropriations for salaries of State engineer and assistants were as follows: State engineer, $5,000; deputy, $4,000; chief clerk, $3,000; land clerk, $2,000; canal clerk, $1,800; record clerk, $1,100; three stenographers, at $1,000 each; one messenger, $600; one watchman, $540. An appropriation of $30,000 was also made for supervision of expenditures in money-system towns.

An appropriation of $100,000 was made (1907, ch. 578) for repair and maintenance of State-aid roads. An appropriation of $57,105.32 was made to reimburse several counties for the maintenance of State-aid roads.

Several changes were made in the State-aid law (1907, ch. 717), but none of them are material, and the fundamental principles of the law remain the same.

The law of 1906 which provides for the sale of bonds for road purposes was amended (1907, ch. 718) by striking out paragraph 3, which provides that bonds be issued in two classes, A and B. Class A bonds were to have been redeemed by the State and Class B by the counties. The basis on which taxes are to be collected for paying interest and principal on the bonds is also changed, the rate depending on the rate of interest the bonds bear.

An appropriation of $240,000 was made for the purpose of paying the annual installment on State-aid road-improvement bonds (1907, ch. 530), this being the amount derived from the special tax levied for the purpose. An appropriation of $175,000 was made out of the sinking fund to pay interest and principal on said bonds. (1907, ch. 533.)

An appropriation of $200,000 is made for the maintenance of roads as provided for by the laws of 1898 and 1906. (1907, ch. 170.) The legislature adopted the map prepared by the State engineer showing the roads which it is proposed to improve under the State-aid law. (1907, ch. 715.) Hereafter State aid will not be extended to any roads which are not shown on this map, except by special legislative enactment.

North Dakota.—Boards of trustees of villages are authorized to assess taxes for streets and roads in such villages. (1907, ch. 267.) This tax must not exceed 5 mills on each $1 of assessed valuation, and is in addition to the 10-mill tax heretofore authorized. This tax may be worked out at the rate of $1.50 per day.

Oregon.—A joint resolution was approved February 18, 1907, requesting the Congress of the United States to pay $10 per mile per annum for the maintenance of all roads on forest reserves in the State, such money to be paid to the county courts of the county in which the roads are located and to be expended under their supervision.

Breaks and leaks in irrigation ditches which cause the water to overflow and injure the public roads must be repaired by the owners of such ditches within six hours after having been notified to do so by the road supervisor in whose district the break is located. (1907, ch. 165.) If the leak is not repaired, the supervisor may have it done and charge the same to the owner of the ditch.

Pennsylvania.—The State-aid law was amended (1907, ch. 325), increasing the salary of the State highway commissioner from $5,000 to $6,500 per annum, and allowing him actual expenses instead of $1,000 per annum. A deputy, who shall be a competent civil engineer and an expert road builder, is also provided for. He is to receive a salary of $3,600 per annum and actual traveling expenses. The number of civil engineers who may be employed is increased from 6 to 12, and the salary of each is increased from $2,000 to $2,400 per annum. One chief draftsman at $2,400 is provided for and 3 assistant draftsmen, instead of 2 as heretofore, their salaries being increased from $1,500 to $1,800 per annum. The salary of the chief clerk is increased from $2,000 to $2,400 per annum. Additional clerks and stenographers at $1,000 per annum may be appointed when necessary.

Hereafter State aid may be extended to incorporated towns as it has heretofore been extended to boroughs in the building of continuous State-aid roads, provided the towns pay one-fourth of the cost of construction. Contractors may now be paid 90 per cent of the contract price upon completion of the work instead of 75 per cent, as heretofore, 10 per cent instead of 25 per cent being withheld until the work is accepted. The provision giving county commissioners authority to select the kind of materials with which State highways are constructed was omitted. The State is to pay three-fourths of the cost of maintaining State highways, instead of one-half the cost as heretofore. In case counties, townships, boroughs, or towns fail to keep State highways in proper repair, the State highway commissioner may have the same repaired and require the proper authorities to pay the balance. The commissioners of any township and the councils of any borough or city may appoint a nonpaid shade-tree commission consisting of three persons, whose duty it shall be to plant, remove, or protect shade trees on all the public highways. (1907, ch. 251.) The cost of planting and of incidental expenses connected therewith is borne by the owner of the property abutting on the road. The cost of maintenance is borne by a special tax, levied for the purpose, of not to exceed 1 mill on the dollar. The powers and duties of the shade-tree commission may be assumed by park boards wherever such boards exist.

Companies operating toll or other roads may be dissolved by the courts of common pleas (1907, ch. 270), after sufficient taxes or tolls have been collected to pay the interest and principal on the original investment. The act providing for the construction and maintenance of side paths being decided unconstitutional by the supreme court, all moneys levied for that purpose must be transferred to the general fund of the counties in which it was collected. (1907, ch. 8.)

SOUTH DAKOTA.—An act approved March 9, 1907 (1907, ch. 162), provides that all road taxes be paid in cash and that $1.50 in cash be paid annually by all those who would be by law subject to road duty. Before becoming operative, however, this law must be agreed to by a majority of the legal voters. This law also abolishes the office of road overseer and provides that the duties heretofore performed by such overseer may hereafter be performed by the township supervisors or by persons employed by them.

TENNESSEE.—The appointment of a State highway commissioner and two assistants was provided for. (1907, ch. 560.) The State highway commissioner is to receive a salary of $2,500 per annum and the assistant commissioners $2,000 per annum. They are to be appointed by the governor, one from east, one from middle, and one from west Tennessee, and their term of office is fixed at two years. An annual appropriation of $500,000 is authorized with which to improve the most important roads in the various counties, and elaborate provisions are made for the inauguration of this work, but the appropriation must be paid "out of the surplus after paying the amount appropriated to public schools." It is understood that there was no surplus and consequently that the law has not yet gone into effect.

Five acts were passed authorizing counties to issue bonds for road purposes and providing regulations for holding elections for issuing the bonds and for the assessment of taxes to pay the interest and principal. The counties authorized to issue bonds and the amounts which may be issued are as follows: Fayette County, $200,000 (1907, ch. 526); Greene County, $150,000 (1907, ch. 525); Washington County, $300,000 (1907, ch. 483); Rome County, $60,000 (1907, ch. 150); Madison County, $200,000 (1907, ch. 491).

Special laws were passed for the counties of Giles, Hawkins, Knox, Lauderdale, Madison, Maury, Morgan, Montgomery, Obion, Scott, Shelby, Smith, Sumner, Tipton, and Wilson.

TEXAS.—Any county, or political subdivision thereof, is authorized to issue bonds for constructing and maintaining public roads (1907, ch. 134), provided the same is agreed to by two-thirds of those voting. The value of bonds must not exceed 25 per cent of the value of real property. They may extend forty years and bear interest not to exceed 5½ per cent. A tax of not more than 15 cents on each $100 may be levied to pay interest and principal.

UTAH.—A State appropriation of $2,000 was made for the improvement of roads in Juab County. (1907, ch. 165.) The money is to be expended under the direction of the Juab county commissioners.

WASHINGTON.—A State highway board composed of the State highway commissioner, the State auditor, and the State treasurer was created. (1907, ch. 149.) The State highway commissioner must be a capable and experienced civil engineer and surveyor and is to receive a salary of $2,500, and not to exceed $1,000 for expenses. The employment of civil engineers, draftsmen, and other assistants is authorized. The State board is to have charge of the construction of all State roads, and is to apportion the amounts appropriated for State roads among the various counties.

A State-aid law very similar to the Higbie-Armstrong law of New York was adopted. (1907, ch. 450.) As in New York, the State pays one-half of the cost, the balance being a charge on the counties, the civil subdivisions of counties, and the property benefited. An appropriation of $135,000 was made, out of which to pay the State's share of the cost. State-aid roads are to be built by contract let by the State highway board and are to be maintained by the counties under the direction of the State highway commissioner. In districts where such roads have been built, all road taxes must hereafter be paid in cash. An amendment to an act passed in 1905 provides for a tax of 0.5 mill on each dollar's worth of property in the State for the purpose of raising money to be used in the construction and repair of highways and bridges. (1907, ch. 18.)

An appropriation of $225,000 was made to pay for the construction of 13 State roads. (1907, ch. 151.) These roads are located in sparsely settled regions and the entire expense of engineering and construction is paid by the State. They are called "State roads," while those built in cooperation with the counties, districts, and property owners are called "State-aid roads." An appropriation of $42,142.75 was made to complete 10 other State roads. (1907 ch. 72.) The State highway commissioner is authorized to survey and report upon the advisability of constructing five roads spe-

cifically mentioned. (1907, ch. 116.) Convicts confined in the State penitentiary and not otherwise employed may be used in the construction of State roads, the cost of their guarding, transportation, and maintenance to be paid from the fund appropriated for each particular road.

WISCONSIN.—The State Geological and Natural History Survey is authorized (1907, ch. 641) to investigate road conditions throughout the State, to conduct experiments, and to collect and disseminate information regarding the best kinds of materials and the best methods of constructing roads and bridges. It is also authorized to collect information regarding the mileage of roads, methods of administration, road expenditures, etc. An appropriation of $10,000 was made to defray the expenses of this investigation.

The legislature of 1905 proposed and agreed to an amendment to the State constitution which provided that the State may appropriate money to aid in the improvement of the public roads. This amendment was ratified and agreed to by the legislature of 1907 (ch. 238), and is to be submitted to the people in November, 1908.

County boards are authorized to elect a competent highway commissioner who shall hold office three years and whose salary shall be not less than $2.50 nor more than $4 per diem, the same to be fixed by the county board and to be paid out of the general county fund (1907, ch. 487). The highway commissioner shall exercise general supervision over all county highways and in cooperation with the chairman of each town is required to make an annual report of expenditures and of work done to the county clerk before the annual meeting of the county board. The county board is authorized to designate and map out a system of county roads which shall extend into every town in the county and constitute continuous lines. A tax of not to exceed 0.75 mill on each dollar's worth of assessed property may be levied for the purpose of raising money with which to construct and repair county roads. Ten per cent of this money is to be set aside for repairs. County roads may be constructed and repaired by contract.

In order to encourage the use of wide tires a rebate of one-half of road taxes will hereafter be received by those using such tires (1907, ch. 479). The rebate, however, is limited as follows: For wagons carrying 1,000 pounds or over and having tires 3 to 3½ inches in width $2 will be allowed, but $3 will be allowed if the tires exceed 3½ inches in width.

WEST VIRGINIA.—The governor is authorized to appoint a State highway inspector who is to serve two years at a salary of $2,000 per annum (1907, ch. 60), and actual traveling expenses not to exceed $1,000. He is required to investigate road conditions throughout the State and to recommend to the governor and the next session of the legislature such changes in road laws as in his judgment will remedy existing defects. He is also required to make a complete report regarding road mileage and conditions, revenues and expenditures, and methods of road administration in every county. The chemical and engineering departments of the State University and the State Board of Agriculture are authorized to cooperate with him.

STATISTICS OF THE PRINCIPAL CROPS.

[Figures furnished by the Bureau of Statistics, Department of Agriculture, except where otherwise credited. All prices on gold basis.]

CORN.

Corn crop of countries named, 1902–1906.

Country.	1902.	1903.	1904.	1905.	1906.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	2,523,648,000	2,244,177,000	2,467,481,000	2,707,994,000	2,927,416,000
Canada (Ontario)[a]	21,159,000	30,211,000	20,880,000	21,582,000	24,745,000
Mexico	78,099,000	90,879,000	88,131,000	85,000,000	70,000,000
Total North America	2,622,906,000	2,365,267,000	2,576,492,000	2,814,576,000	3,022,161,000
SOUTH AMERICA.					
Argentina	84,018,000	148,948,000	175,189,000	140,708,000	194,912,000
Chile	866,000	1,118,000	1,477,000	1,244,000	846,000
Uruguay	5,060,000	5,289,000	3,035,000	4,417,000	3,226,000
Total South America	89,944,000	155,355,000	179,701,000	146,369,000	198,984,000
EUROPE.					
Austria-Hungary:					
Austria	13,462,000	16,056,000	12,529,000	17,293,000	18,177,000
Hungary proper	104,546,000	135,751,000	59,400,000	94,045,000	162,923,000
Croatia-Slavonia	15,255,000	23,776,000	11,364,000	18,385,000	25,600,000
Bosnia-Herzegovina	5,863,000	8,411,000	6,464,000	9,584,000	8,936,000
Total Austria-Hungary	139,126,000	183,994,000	89,757,000	139,307,000	215,636,000
Bulgaria	18,100,000	22,836,000	12,758,000	19,649,000	20,000,000
France	24,928,000	25,360,000	19,482,000	24,030,000	14,581,000
Italy	71,028,000	88,990,000	90,545,000	97,265,000	93,007,000
Portugal	16,000,000	14,000,000	15,000,000	16,000,000	16,000,000
Roumania	68,447,000	80,272,000	19,598,000	59,275,000	130,546,000
Russia:					
Russia proper	40,377,000	40,397,000	18,956,000	22,533,000	59,320,000
Poland	....	....	13,000	....	....
Northern Caucasia	8,042,000	10,067,000	6,951,000	10,798,000	11,181,000
Total Russia (European)	48,419,000	50,464,000	25,920,000	33,331,000	70,501,000
Servia	18,396,000	19,479,000	9,498,000	21,431,000	27,786,000
Spain	25,272,000	18,759,000	21,300,000	31,880,000	30,000,000
Total Europe	429,716,000	504,154,000	303,858,000	442,168,000	618,057,000
AFRICA.					
Algeria	556,000	435,000	391,000	490,000	400,000
Cape of Good Hope	2,000,000	3,502,000	3,000,000	3,000,000	3,000,000
Egypt	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000
Natal	4,143,000	1,997,000	5,282,000	3,845,000	4,000,000
Sudan (Anglo-Egyptian)	200,000	184,000	189,000	320,000	300,000
Total Africa	36,899,000	36,118,000	38,862,000	37,655,000	37,700,000
AUSTRALASIA.					
Australia:					
Queensland	2,650,000	1,066,000	1,984,000	2,623,000	2,233,000
New South Wales	3,966,000	3,145,000	7,052,000	5,107,000	5,714,000
Victoria	635,000	774,000	933,000	643,000	661,000
Western Australia	5,000	2,000	3,000	1,000	....
Total Australia	7,256,000	4,987,000	9,972,000	8,374,000	8,608,000
New Zealand	590,000	627,000	547,000	506,000	653,000
Total Australasia	7,846,000	5,614,000	10,519,000	8,880,000	9,261,000
Grand total	3,187,311,000	3,066,508,000	3,109,432,000	3,449,648,000	3,886,163,000

[a] Officially reported as "Corn in the ear."

Acreage, production, value, prices, and exports of corn in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including corn meal, fiscal year beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1850 *a*	....	......	592,071,104	......	....	......	......	......	......	....
1860 *a*	....	......	838,792,742	......	....	......	......	......	......	....
1866	34,306,538	25.3	867,946,295	47.4	411,450,830	53	62	64	79	16,026,947
1867	32,520,249	23.6	768,320,000	57.0	437,769,763	61	65	61	71	12,493,522
1868	34,887,246	26.0	906,527,000	46.8	424,056,649	38	58	44	51	8,286,665
1869	37,103,245	23.6	874,320,000	59.8	522,550,509	56	67	73	85	2,140,487
1870	38,646,977	28.3	1,094,255,000	49.4	540,520,456	41	59	46	52	10,676,873
1871	34,091,137	29.1	991,898,000	43.4	430,355,910	36	39	38	43	35,727,010
1872	35,526,836	30.8	1,092,719,000	35.3	385,736,210	27	28	34	39	40,154,374
1873	39,197,148	23.8	932,274,000	44.2	411,961,151	40	49	49	59	35,985,834
1874	41,036,918	20.7	850,148,500	58.4	496,271,255	64	76	53	67	30,025,036
1875	44,841,371	29.5	1,321,069,000	36.7	484,674,804	40	47	41	45	50,910,532
1876	49,033,364	26.2	1,283,827,500	34.0	436,108,521	40	43	43	56	72,652,611
1877	50,369,113	26.7	1,342,558,000	34.8	467,635,230	41	49	35	41	87,192,110
1878	51,585,000	26.9	1,388,218,750	31.7	440,280,517	30	32	33	36	87,884,892
1879	53,085,450	29.2	1,547,901,790	37.5	580,486,217	39	43¼	32⅜	36⅛	99,572,329
1880	62,317,842	27.6	1,717,434,543	39.6	679,714,499	35⅝	42	41½	45	93,648,147
1881	64,262,025	18.6	1,194,916,000	63.6	759,482,170	58½	63½	69	76⅞	44,340,683
1882	65,659,545	24.6	1,617,025,100	48.5	783,867,175	49¼	61	53¼	56¾	41,655,653
1883	68,301,889	22.7	1,551,066,895	42.4	658,051,485	54¼	63⅛	52½	57	46,258,606
1884	69,683,780	25.8	1,795,528,432	35.7	640,735,859	34½	40¼	44¾	49	52,876,456
1885	73,130,150	26.5	1,936,176,000	32.8	635,674,630	36	42¾	34¼	36¾	64,829,617
1886	75,694,208	22.0	1,665,441,000	36.6	610,311,000	35¾	38	36⅞	39⅜	41,368,584
1887	72,392,720	20.1	1,456,161,000	44.4	646,106,770	47	51⅜	54	60	25,360,869
1888	75,672,763	26.3	1,987,790,000	34.1	677,561,580	33½	35⅞	33⅛	35⅜	70,841,673
1889	78,319,651	27.0	2,112,892,000	28.3	597,918,829	29¼	35	32¾	35	103,418,709
1890	71,970,763	20.7	1,489,970,000	50.6	754,433,451	47¾	53	55	69½	32,041,529
1891	76,204,515	27.0	2,060,154,000	40.6	836,439,228	39⅜	59	40¾	*b*100	76,602,285
1892	70,626,658	23.1	1,628,464,000	39.4	642,146,630	40	42⅞	39½	44½	47,121,894
1893	72,036,465	22.5	1,619,496,131	36.5	591,625,627	34¼	36½	36¾	38½	66,489,529
1894	62,582,269	19.4	1,212,770,052	45.7	554,719,162	44¾	47½	47¾	55½	28,585,405
1895	82,075,830	26.2	2,151,138,580	25.3	544,985,534	25	26¾	27½	29½	101,100,375
1896	81,027,156	28.2	2,283,875,165	21.5	491,006,967	22½	23¾	23	25½	178,817,417
1897	80,095,051	23.8	1,902,967,933	26.3	501,072,952	25	27½	32⅜	37	212,055,543
1898	77,721,781	24.8	1,924,184,660	28.7	552,023,428	33⅛	38	32½	34⅜	177,255,046
1899	82,108,587	25.3	2,078,143,933	30.3	629,210,110	30	31½	36	40½	213,123,412
1900	83,320,872	25.3	2,105,102,516	35.7	751,220,034	35¼	40½	42⅝	58½	181,405,473
1901	91,349,928	16.7	1,522,519,891	60.5	921,555,768	62½	67½	59⅛	64¾	28,028,688
1902	94,043,613	26.8	2,523,648,312	40.3	1,017,017,349	43¾	57¼	44	46	76,639,261
1903	88,091,993	25.5	2,244,176,925	42.5	952,868,801	41	43¾	47¼	50	58,222,061
1904	92,231,581	26.8	2,467,480,934	44.1	1,087,461,440	43½	49	48	64½	90,293,483
1905	94,011,369	28.8	2,707,993,540	41.2	1,116,696,738	42	50¼	47½	50	119,893,833
1906	96,737,581	30.3	2,927,416,091	39.9	1,166,626,479	40	46	49½	56	86,367,988
1907	99,931,000	25.9	2,592,320,000	51.6	1,336,901,000	57½	61½	67¾	82	....

a Census figures. *b* Coincident with "corner."

Condition of the corn crop in the United States, monthly, 1887–1907.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1887	97.7	80.5	72.3	72.8	1894	95.0	69.1	63.4	64.2	1901	81.3	54.0	51.7	52.1
1888	93.0	95.5	94.2	92.0	1895	99.3	102.5	96.4	95.5	1902	87.5	86.5	84.3	79.6
1889	90.3	94.8	90.9	91.7	1896	92.4	96.0	91.0	90.5	1903	79.4	78.7	80.1	80.8
1890	93.1	73.3	70.1	70.6	1897	82.9	84.2	79.3	77.1	1904	86.4	87.3	84.6	83.9
1891	92.8	90.8	91.1	92.5	1898	90.5	87.0	84.1	82.0	1905	87.3	89.0	89.5	89.2
1892	81.1	82.5	79.6	79.8	1899	86.5	89.9	85.2	82.7	1906	87.5	88.1	90.2	90.1
1893	93.2	87.0	76.7	75.1	1900	89.5	87.5	80.6	78.2	1907	80.2	82.8	80.2	78.0

Acreage, production, value, and distribution of corn in the United States in 1907, by States.

State or Territory.	Crop of 1907. Acreage.	Crop of 1907. Production.	Crop of 1907. Farm value Dec. 1.	Stock in farmers' hands March 1, 1908.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	12,000	444,000	333,000	107,000	24	0
New Hampshire	26,000	910,000	682,000	218,000	24	0
Vermont	55,000	1,980,000	1,485,000	495,000	25	0
Massachusetts	44,000	1,584,000	1,188,000	475,000	30	0
Rhode Island	10,000	312,000	250,000	109,000	35	3,000
Connecticut	56,000	1,848,000	1,386,000	517,000	28	18,000
New York	600,000	16,200,000	11,502,000	4,050,000	25	162,000
New Jersey	278,000	8,757,000	5,517,000	4,028,000	46	1,051,000
Pennsylvania	1,413,000	45,922,000	29,390,000	17,910,000	39	2,296,000
Delaware	193,000	5,308,000	2,760,000	2,654,000	50	1,858,000
Maryland	649,000	22,196,000	11,986,000	10,432,000	47	7,103,000
Virginia	1,841,000	46,025,000	29,456,000	21,632,000	47	5,063,000
West Virginia	760,000	21,280,000	15,322,000	7,235,000	34	1,064,000
North Carolina	2,732,000	45,078,000	33,358,000	21,637,000	48	1,803,000
South Carolina	1,974,000	29,807,000	23,249,000	15,202,000	51	894,000
Georgia	4,426,000	57,538,000	43,729,000	25,892,000	45	1,726,000
Florida	621,000	7,017,000	5,614,000	2,526,000	36	211,000
Ohio	3,400,000	117,640,000	61,173,000	43,527,000	37	25,881,000
Indiana	4,690,000	168,840,000	75,978,000	69,224,000	41	48,964,000
Illinois	9,521,000	342,756,000	150,813,000	140,530,000	41	137,102,000
Michigan	1,900,000	57,190,000	31,455,000	17,729,000	31	1,716,000
Wisconsin	1,459,000	46,688,000	25,678,000	12,139,000	26	1,401,000
Minnesota	1,615,000	43,605,000	21,802,000	10,901,000	25	3,924,000
Iowa	9,160,000	270,220,000	116,195,000	99,981,000	37	37,831,000
Missouri	7,775,000	241,025,000	113,282,000	89,179,000	37	33,744,000
North Dakota	154,000	3,080,000	1,848,000	616,000	20	62,000
South Dakota	1,850,000	47,175,000	21,700,000	14,152,000	30	6,133,000
Nebraska	7,472,000	179,328,000	73,524,000	60,972,000	34	48,419,000
Kansas	7,020,000	155,142,000	68,262,000	43,440,000	28	31,028,000
Kentucky	3,300,000	93,060,000	49,322,000	37,224,000	40	7,445,000
Tennessee	3,014,000	78,364,000	44,667,000	33,697,000	43	11,755,000
Alabama	2,961,000	45,896,000	34,422,000	20,653,000	45	1,377,000
Mississippi	2,500,000	42,500,000	31,875,000	17,000,000	40	850,000
Louisiana	1,600,000	28,000,000	19,600,000	7,560,000	27	280,000
Texas	7,409,000	155,589,000	93,353,000	51,344,000	33	14,003,000
Oklahoma	4,650,000	113,265,000	49,837,000	40,775,000	36	30,582,000
Arkansas	2,525,000	43,430,000	29,532,000	15,200,000	35	1,303,000
Montana	4,000	90,000	61,000	16,000	18	1,000
Wyoming	3,000	75,000	52,000	19,000	25	0
Colorado	111,000	2,608,000	1,695,000	652,000	25	261,000
New Mexico	42,000	1,218,000	877,000	256,000	21	49,000
Arizona	8,000	300,000	270,000	54,000	18	15,000
Utah	11,000	280,000	202,000	50,000	18	6,000
Idaho	5,000	150,000	105,000	33,000	22	2,000
Washington	12,000	324,000	227,000	55,000	17	10,000
Oregon	16,000	440,000	326,000	57,000	13	4,000
California	54,000	1,836,000	1,561,000	275,000	15	275,000
United States	99,931,000	2,592,320,000	1,336,901,000	962,429,000	37.1	467,675,000

Average yield per acre of corn in the United States, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	40.0	36.0	36.0	39.4	21.7	30.2	39.7	34.3	37.0	37.0
New Hampshire	41.0	39.0	37.0	38.5	23.3	21.0	27.3	37.0	37.5	35.0
Vermont	43.0	36.0	40.0	40.0	21.8	23.4	35.9	34.7	35.5	36.0
Massachusetts	40.0	36.0	38.0	40.5	31.3	24.0	36.0	37.5	39.7	36.0
Rhode Island	34.0	31.0	32.0	32.1	28.4	30.1	34.1	32.5	33.1	31.2
Connecticut	37.0	39.0	38.0	39.0	31.5	22.4	38.9	42.7	40.0	33.0
New York	33.0	31.0	32.0	33.0	25.0	25.0	27.3	31.5	34.9	27.0
New Jersey	37.0	39.0	33.0	36.9	34.5	24.0	38.0	35.8	36.3	31.5
Pennsylvania	37.0	32.0	25.0	35.0	36.1	31.2	34.0	38.9	40.2	32.5
Delaware	25.0	22.0	24.0	30.0	28.0	27.5	30.4	30.4	30.0	27.5
Maryland	31.0	32.0	26.0	34.2	32.4	28.7	33.4	36.9	35.0	34.2
Virginia	22.0	20.0	16.0	22.2	22.0	21.8	23.3	23.4	24.3	25.0
West Virginia	29.0	26.0	27.0	23.0	26.5	22.6	25.3	29.8	30.3	28.0
North Carolina	14.0	13.0	12.0	12.0	13.9	14.7	15.2	13.9	15.3	16.5
South Carolina	10.0	9.0	7.0	6.9	10.4	10.3	12.4	10.9	12.2	15.1
Georgia	9.0	10.0	10.0	10.0	9.0	11.7	11.9	11.0	12.0	13.0
Florida	9.0	10.0	8.0	9.0	8.6	9.9	10.7	10.1	11.0	11.3
Ohio	37.0	36.0	37.0	26.1	38.0	29.6	32.5	37.8	42.6	34.6
Indiana	36.0	38.0	38.0	19.8	37.9	33.2	31.5	40.7	39.6	36.0
Illinois	30.0	36.0	37.0	21.4	38.7	32.2	36.5	39.8	36.1	36.0
Michigan	34.0	25.0	36.0	34.5	26.4	33.5	28.6	34.0	37.0	30.1
Wisconsin	35.0	35.0	40.0	27.4	28.2	29.3	29.7	37.6	41.2	32.0
Minnesota	32.0	33.0	33.0	26.3	22.8	28.3	26.9	32.5	33.6	27.0
Iowa	35.0	31.0	38.0	25.0	32.0	28.0	32.6	34.8	39.5	29.5
Missouri	26.0	26.0	28.0	10.1	39.0	32.4	26.2	33.8	32.3	31.0
North Dakota	19.0	23.0	16.0	22.6	19.4	25.2	21.2	27.5	27.8	20.0
South Dakota	28.0	26.0	27.0	21.0	18.9	27.2	28.1	31.8	33.5	25.5
Nebraska	21.0	28.0	26.0	14.1	32.3	26.0	32.8	32.8	34.1	24.0
Kansas	16.0	27.0	19.0	7.8	29.9	25.6	20.9	27.7	28.9	22.1
Kentucky	31.0	21.0	26.0	15.6	27.0	26.6	26.9	29.7	33.0	28.2
Tennessee	26.0	20.0	20.0	14.2	21.9	23.5	25.0	24.6	28.1	26.0
Alabama	15.0	12.0	11.0	10.9	8.4	14.8	15.0	14.8	16.0	15.5
Mississippi	18.0	16.0	11.0	10.9	11.5	18.4	19.1	14.3	18.5	17.0
Louisiana	18.0	18.0	17.0	13.7	12.5	20.6	19.9	13.7	17.2	17.5
Texas	25.0	18.0	18.5	11.6	8.1	24.2	22.6	21.3	22.5	21.0
Indian Territory	......	......	......	12.0	24.9	27.7	32.4	32.7	33.6	24.4
Oklahoma	......	19.0	26.0	7.3	25.8	23.3	28.1	25.3	32.9	
Arkansas	20.0	20.0	19.0	8.1	21.3	20.9	21.6	17.3	23.6	17.2
Montana	28.0	23.0	15.0	25.0	22.0	24.1	22.2	19.4	23.4	22.5
Wyoming	16.0	22.0	34.0	39.5	19.8	19.4	32.5	26.9	27.0	25.0
Colorado	18.0	17.0	19.0	17.1	16.5	19.8	20.5	23.8	27.9	23.5
New Mexico	21.0	20.0	22.0	31.6	22.0	24.0	22.7	25.3	29.4	29.0
Arizona	......	......	......	18.0	20.2	22.4	23.8	27.0	29.5	37.5
Utah	21.0	20.0	20.0	19.4	20.1	21.4	33.2	36.2	32.0	25.5
Idaho	......	......	......	23.0	24.7	34.5	29.3	27.2	28.3	30.0
Washington	12.0	23.0	20.0	17.5	23.0	23.1	24.7	24.2	25.2	27.0
Oregon	24.0	22.0	23.0	20.8	23.4	25.8	28.8	23.0	27.6	27.5
California	26.0	27.0	25.0	31.0	30.5	30.7	28.6	32.0	34.9	34.0
General average	24.8	25.3	25.3	16.7	26.8	25.5	26.8	28.8	30.3	25.9

Average farm value per acre of corn in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$19.20	$18.00	$19.80	$29.94	$16.06	$19.93	$32.16	$23.67	$23.68	$27.75
New Hampshire	18.86	19.11	20.72	30.03	17.01	13.23	19.66	25.53	24.00	26.23
Vermont	18.92	16.92	20.00	29.20	14.82	14.51	26.21	23.60	20.95	27.00
Massachusetts	19.60	18.36	20.52	30.78	23.16	15.84	25.92	26.25	23.82	27.00
Rhode Island	21.76	16.43	21.44	24.40	22.15	24.38	28.64	23.08	21.18	25.00
Connecticut	19.24	19.50	20.90	29.25	23.31	15.01	28.40	30.32	24.00	24.75
New York	14.19	13.95	15.04	23.76	16.75	15.00	17.47	19.21	20.59	19.17
New Jersey	14.80	15.60	14.85	24.35	19.32	13.68	22.04	19.69	19.24	19.85
Pennsylvania	14.80	13.12	11.25	21.70	20.94	17.78	20.06	21.01	20.90	20.80
Delaware	7.75	7.48	9.12	17.10	13.72	13.48	14.90	14.29	12.60	14.30
Maryland	10.85	11.52	10.66	19.84	16.52	14.64	16.70	17.71	15.75	18.47
Virginia	7.70	7.60	7.84	13.10	11.44	11.55	13.75	12.40	13.37	16.00
West Virginia	10.73	11.70	13.50	14.95	14.31	14.46	16.19	15.79	16.66	20.16
North Carolina	6.02	6.11	6.84	8.76	8.34	8.97	9.42	8.90	10.40	12.21
South Carolina	4.60	4.50	4.48	5.80	7.18	7.11	8.68	8.07	8.91	11.78
Georgia	4.32	5.00	5.70	8.20	6.57	8.07	8.45	7.70	8.04	9.88
Florida	4.50	5.30	4.80	7.65	6.62	7.23	8.02	6.67	6.82	9.04
Ohio	9.99	10.80	12.58	14.88	15.96	13.91	14.95	16.25	16.61	17.99
Indiana	9.00	10.26	12.16	10.89	13.64	11.95	12.91	15.47	14.26	16.20
Illinois	7.50	9.36	11.84	12.20	13.93	11.59	14.23	15.12	13.00	15.84
Michigan	11.56	9.00	13.32	17.94	13.73	15.41	14.87	15.64	16.28	16.56
Wisconsin	9.80	10.50	13.20	14.25	14.10	12.60	13.66	15.79	16.89	17.60
Minnesota	7.68	7.92	9.57	11.83	9.12	10.75	9.68	10.72	11.42	13.50
Iowa	8.05	7.13	10.26	13.00	10.56	10.64	10.76	11.83	12.64	12.69
Missouri	7.02	7.80	8.96	6.77	12.87	11.02	11.53	12.51	12.27	14.57
North Dakota	6.84	7.59	6.72	10.40	8.73	10.58	8.48	9.90	10.84	12.00
South Dakota	6.44	6.76	7.83	9.45	7.75	9.52	10.12	9.86	9.72	11.73
Nebraska	4.62	6.44	8.06	7.61	9.69	7.28	10.82	10.50	9.89	9.84
Kansas	4.16	6.75	6.08	4.91	10.17	9.22	8.57	9.14	9.25	9.72
Kentucky	8.37	7.77	10.40	9.52	11.34	14.90	13.18	12.77	13.86	14.95
Tennessee	7.54	7.80	9.80	9.23	10.29	11.52	12.50	12.30	13.21	14.82
Alabama	6.15	5.64	6.38	8.39	5.63	8.44	9.00	9.47	10.24	11.63
Mississippi	7.02	7.36	6.38	8.07	7.02	9.94	10.70	9.30	11.28	12.75
Louisiana	7.38	7.92	8.50	10.27	8.25	11.95	11.34	8.36	10.32	12.25
Texas	8.50	6.48	8.46	9.28	5.35	11.62	11.75	10.44	11.25	12.60
Indian Territory	......	......	......	9.12	10.71	10.80	12.96	12.10	10.75	10.72
Oklahoma	......	3.80	6.76	5.55	10.06	8.85	10.96	8.10	9.87	
Arkansas	5.80	7.60	8.17	6.56	10.44	10.66	11.45	9.51	11.09	11.70
Montana	18.48	11.96	8.85	22.50	15.84	14.94	15.10	13.19	15.21	15.25
Wyoming	8.80	9.46	20.40	28.44	11.68	11.25	18.52	20.17	15.93	17.33
Colorado	7.20	7.31	9.12	12.65	9.73	10.69	11.07	11.19	13.95	15.27
New Mexico	11.76	11.60	14.08	24.33	17.16	18.00	17.71	17.46	21.17	20.88
Arizona	......	......	......	16.20	20.40	20.16	21.66	26.19	25.08	33.75
Utah	12.60	11.80	12.60	17.46	13.47	14.98	23.90	25.34	23.68	18.36
Idaho	......	......	......	13.80	15.31	19.67	20.51	17.95	15.85	21.00
Washington	5.04	12.65	11.80	10.15	14.95	12.70	16.30	14.52	13.86	18.92
Oregon	14.40	14.08	13.11	11.86	15.44	17.29	17.57	13.57	17.94	20.38
California	16.12	16.20	15.25	21.08	23.49	22.72	22.31	52.32	23.38	28.91
General average	7.10	7.66	9.02	10.09	10.81	10.82	11.79	11.88	12.06	13.38

Average farm price of corn per bushel in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	48	50	55	76	74	66	81	69	64	75
New Hampshire	46	49	56	78	73	63	72	69	64	75
Vermont	44	47	50	73	68	62	73	68	59	75
Massachusetts	49	51	54	76	74	66	72	70	60	75
Rhode Island	64	53	67	76	78	81	84	71	64	80
Connecticut	52	50	55	75	74	67	73	71	60	75
New York	43	45	47	72	67	60	64	61	59	71
New Jersey	40	40	45	66	56	57	58	55	53	63
Pennsylvania	40	41	45	62	58	57	59	54	52	64
Delaware	31	34	38	57	49	49	49	47	42	52
Maryland	35	36	41	58	51	51	50	48	45	54
Virginia	35	38	49	59	52	53	59	53	55	64
West Virginia	37	45	50	65	54	64	64	53	55	72
North Carolina	43	47	57	73	60	61	62	64	68	74
South Carolina	46	50	64	84	69	69	70	74	73	78
Georgia	48	50	57	82	73	69	71	70	67	76
Florida	50	53	60	85	77	73	75	66	62	80
Ohio	27	30	34	57	42	47	46	43	39	52
Indiana	25	27	32	55	36	36	41	38	36	45
Illinois	25	26	32	57	36	36	39	38	36	44
Michigan	34	36	37	52	52	46	52	46	44	55
Wisconsin	28	30	33	52	50	43	46	42	41	55
Minnesota	24	24	29	45	40	38	36	33	34	50
Iowa	23	23	27	52	33	38	33	34	32	43
Missouri	27	30	32	67	33	34	44	37	38	47
North Dakota	36	33	42	46	45	42	40	36	39	60
South Dakota	23	26	29	45	41	35	36	31	29	46
Nebraska	22	23	31	54	30	28	33	32	29	41
Kansas	26	25	32	63	34	36	41	33	32	44
Kentucky	27	37	40	61	42	56	49	43	42	53
Tennessee	29	39	49	65	47	49	50	50	47	57
Alabama	41	47	58	77	67	57	60	64	64	75
Mississippi	39	46	58	74	61	54	56	65	61	75
Louisiana	41	44	50	75	66	58	57	61	60	70
Texas	34	36	47	80	66	48	52	49	50	60
Indian Territory	......	......	......	76	43	39	40	37	32	44
Oklahoma	......	20	26	76	39	38	39	32	30	
Arkansas	29	38	43	81	49	51	53	55	47	68
Montana	66	52	59	90	72	62	68	68	65	68
Wyoming	55	43	60	72	59	58	57	75	59	70
Colorado	40	43	48	74	59	54	54	47	50	65
New Mexico	56	58	64	77	78	75	78	69	72	72
Arizona	......	......	......	90	101	90	91	97	85	90
Utah	60	59	63	90	67	70	72	70	74	72
Idaho	......	......	......	60	62	57	70	66	56	70
Washington	42	55	59	58	65	55	66	60	55	70
Oregon	60	64	57	57	66	67	61	59	65	74
California	62	60	61	68	77	74	78	76	67	85
General average	28.7	30.3	35.7	60.5	40.3	42.5	44.1	41.2	39.9	51.6

Wholesale prices of corn per bushel, 1903–1907.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		Mixed.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*		
January	55	68½	51½	60	43½	48½	43¾	48⅛	47	49	40	44½	$1.30	$1.40
February	55¾	59	52½	55	46	48	42½	45	47	48	41	44¾	1.30	1.37½
March	50⅞	56¼	47¾	52¾	41½	47	41⅜	45⅝	40½	47½	39	45	1.17½	1.35
April	51	53½	48½	52½	40	46	41¾	45¼	41½	45½	39½	42½	1.17½	1.27½
May	52¾	55	51	55½	45½	47¾	44	46	46½	48	41½	47½	1.17½	1.27½
June	56	60⅝	54½	59	48½	54	47¼	52	49½	55	48	55	1.20	1.30
July	56⅛	60	58½	61	50	53	49	53	51	55½	48	51¾	1.25	1.57½
August	58¼	60¼	58	60	52½	54½	50½	53	54½	55½	48	51½	1.55	1.57½
September	53¼	59¾	56	60	48	53	45¼	52¾	51	56½	45	50	1.47½	1.57½
October	51¼	54	53	55	45½	49	43½	46	47½	51½	41½	45	1.30	1.50
November	49¼	52⅜	46½	54½	45½	46	41⅜	44¾	46½	48½	41½	43¼	1.25	1.35
December	49½	53½	46¾	49¼	44½	46	41	43¾	44	48½	41½	45	1.25	1.35
1904.									No. 3.					
January	51½	56	49¼	50⅝	45½	46½	42¾	47½	42	44	43½	45½	1.27½	1.32½
February	53	63	49⅞	54½	45½	47½	46	54½	43½	46	44½	48½	1.25	1.35
March	54¼	57	50¼	52¾	46	51	49	56½	44½	46½	44	49¼	1.30	1.45
April	52¾	56	50⅛	52½	50½	54	46½	56⅞	48½	51½	48	51½	1.37½	1.45
May	55½	60	51½	54	51½	56½	47¼	50	51	52½	48	54	1.42½	1.45
June	47⅛	50½	50½	53¾	48	51	53¼	59½	48½	52	47	50½	1.40	1.47½
July	53½	55⅜	50½	53¼	48	53½	47¼	50	49	51½	48½	52¾	1.40	1.55
August	55⅜	62⅛	53½	58½	52½	57½	51¼	55¾	51½	57½	51½	55	1:40	1.55
September	56½	60¼	56½	58¾	55	57	51	54¾	53½	54½	51	54	1.50	1.55
October	55⅝	62¼	......	......	55½	59	50	57¼	52	58½	51½	54½	1.40	1.55
November	54⅞	69	53	55	56½	58½	50	58⅛	47½	60	48½	57	1.37½	1.55
December	53	54¾	49¾	52½	45½	52	43½	49	44½	47¾	42½	49	1.25	1.55
1905.														
January	51¼	52½	44¼	50½	45½	46	42	43¼	45	46¾	43¾	45	1.25	1.55
February	51	54⅜	44	50¾	46	48½	42¾	45½	45½	48½	44	47	1.32½	1.45
March	52	54¾	45½	54	48	52	45½	48½	48½	51½	46	49	1.32½	1.40
April	51	52¾	48	52½	47½	50½	46	49½	49½	50	46¼	49½	1.32½	1.40
May	52	58¼	48½	56½	49	54½	48	64½	49½	54	48	53	1.32½	1.50
June	57¾	62½	50¾	64	54	57	51¾	56¾	54	57¼	50½	56	1.40	1.45
July	59¾	63½	58	65	57	59½	53¾	59	57½	58	51	58½	1.40	1.42½
August	60	62¾	56	63½	54	57½	53	57	55½	57	51½	54½	1.40	1.42½
September	59	61	56	63	54½	56½	51¼	54½	54½	55½	51½	54½	1.32½	1.40
October	58¼	62½	51	63	53½	56½	50	54½	55½	59	50	53½	1.30	1.32½
November	52½	62½	42	61	45½	53	45½	51½	44¾	55½	41½	51½	1.30	1.37½
December	50¾	53¼	42	51½	44½	47	42	50¼	44¾	45¾	41½	46½	1.32½	1.37½
1906.														
January	49½	51¼	47¾	49⅞	44	46	41	43	44½	45¾	41¾	43¾	......	......
February	47	49¾	45⅝	48⅜	42	44¾	41¼	45½	43	46¾	39¾	42⅝	......	......
March	47¼	52	46	49⅜	43	48	39	44	43¼	47	40¼	44½	......	......
April	52	56¼	49⅝	54¼	47	52½	43½	48	48¼	52	43½	51½	......	......
May	55¾	58	55	57¼	51½	53½	47½	50	50¾	53½	49	51	......	......
June	58	61½	55	58	51½	54	50	54¾	52	55	48	53½	......	......
July	56¾	60	55¼	57¾	53½	55½	49½	53¼	53	55	50½	54½	......	......
August	55	58	54¼	55¾	50½	54¼	48½	51	52¼	54	46½	51	......	......
September	56¼	58½	53½	54¾	48	50½	47	50	49	52	46	47½	......	......
October	54¼	56	51⅛	54½	48	50	44¾	47¼	48¼	49¾	44	46	......	......
November	52¾	56	49	52	47½	48½	44	47¼	48¾	49¾	41	45½	......	......
December	50	53	50	51½	43	48	40	46	43½	49½	39½	45	......	......
1907.														
January	49½	52	......	......	43	47	39¾	43½	43	46	39	43	1.25	1.40
February	51¾	54½	......	......	46	48	43	44¼	45¾	46½	42½	45½	1.25	1.35
March	51¾	54	......	......	46½	48¼	43	45	45	47	43	45½	1.27½	1.35
April	51¾	57¾	......	......	47½	53½	44¼	50¾	45½	50½	43	50½	1.27½	1.40
May	56½	63	......	......	52½	57½	49½	56	50½	56¼	49	55½	1.35	1.55
June	60½	65	......	......	55	56½	51¾	54½	53½	56½	50¾	54	......	......
July	60	63	......	......	55½	57	52	55¼	54¾	57	51¾	55	1.50	1.60
August	60¼	67⅝	......	......	56½	63	54	61½	57	62	53¼	60	1.50	1.57½
September	67¼	77	......	......	63	66	60½	63¾	62	69½	59	63	1.52½	1.60
October	69	76⅛	......	......	58	71	55¾	66½	63	69½	53½	66	......	......
November	64½	71¼	......	......	59	62½	55½	60½	62	64	56	59½	......	......
December	67	76	......	......	60	61½	57½	61½	58	64½	51½	59	......	......

International trade in corn, including corn meal, 1902-1906.

General Note.—Substantially the international trade of the world. It should not be expected that the world's export and import totals for any year will agree. Among sources of disagreement are these: (1) Different periods of time covered in the "year" of the various countries; (2) imports received in year subsequent to year of export; (3) want of uniformity in classification of goods among countries; (4) different practices and varying degrees of failure in recording countries of origin and ultimate destination; (5) different practices of recording reexported goods; (6) opposite methods of treating free ports; (7) clerical errors, which, it may be assumed, are not infrequent.

The exports given are domestic exports and the imports given are imports for consumption, as far as it is feasible and consistent so to express the facts. While there are some inevitable omissions from such a table as this, on the other hand, there are some duplications because of reshipments that do not appear as such in official reports. For the United Kingdom import figures refer to imports for consumption.

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Argentina	Jan. 1	46,959,590	82,845,915	97,221,783	87,487,629	106,047,790
Austria-Hungary	Jan. 1	3,010,624	310,804	174,342	63,218	22,361
Belgium	Jan. 1	4,346,609	6,579,655	6,287,688	8,078,215	6,588,557
Bulgaria	Jan. 1	7,883,279	5,089,114	9,762,657	3,870,090	5,658,500
Netherlands	Jan. 1	4,726,324	5,373,194	4,449,009	4,278,515	6,010,176
Roumania	Jan. 1	43,013,192	31,080,198	18,042,377	1,441,437	[a] 23,394,301
Russia	Jan. 1	44,148,590	25,349,683	18,633,663	7,372,386	[b] 9,878,141
Servia	Jan. 1	1,091,588	171,767	130,225	806,115	1,755,446
United States	July 1	76,639,261	58,222,061	90,293,483	119,893,833	86,367,988
Uruguay	July 1	703,770	1,004,063	2,002,431	28,519	[b] 934,696
Other countries	....	1,528,000	1,086,000	1,009,000	4,100,325	[b] 3,547,299
Total	....	234,050,827	217,112,454	248,006,658	237,420,282	250,205,255

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	5,874,971	11,130,274	14,090,377	18,511,368	7,118,221
Belgium	Jan. 1	14,583,008	20,323,863	19,474,330	24,169,780	20,125,507
Canada	July 1	7,154,522	11,333,530	12,003,574	11,779,679	[b] 15,233,894
Cape of Good Hope	Jan. 1	1,943,896	3,471,281	1,236,927	2,171,601	215,007
Cuba	Jan. 1	1,150,176	619,326	696,517	1,843,348	2,489,087
Denmark	Jan. 1	12,355,050	8,772,022	9,284,777	10,859,257	18,855,752
Egypt	Jan. 1	55,266	142,537	53,017	1,279,749	1,438,435
France	Jan. 1	8,674,931	11,347,114	10,124,353	11,122,512	14,509,103
Germany [c]	Jan. 1	35,454,243	37,527,343	30,450,853	36,538,366	44,883,053
Italy	Jan. 1	8,216,902	15,092,527	8,365,123	5,902,875	8,666,763
Mexico	Jan. 1	142,102	496,028	476,182	1,454,327	[b] 2,079,553
Netherlands	Jan. 1	15,817,237	20,160,078	16,547,198	16,234,785	25,305,233
Norway	Jan. 1	637,387	765,246	555,991	544,596	718,277
Portugal	Jan. 1	759,967	366,605	531,889	2,724,050	[d] 2,724,050
Russia	Jan. 1	135,822	457,715	625,526	163,979	[b] 437,868
Spain	Jan. 1	993,272	1,484,490	2,761,426	1,904,186	2,647,975
Sweden	Jan. 1	191,958	189,357	234,986	491,035	564,946
Switzerland	Jan. 1	2,404,644	2,611,202	2,704,457	2,498,380	2,887,291
Transvaal	Jan. 1	1,306,038	2,197,476	1,422,985	1,277,353	[d] 1,277,353
United Kingdom	Jan. 1	89,371,445	101,284,919	86,076,697	84,156,490	97,736,852
Other countries	....	3,260,478	7,318,470	3,309,436	7,429,351	[b] 7,090,991
Total	....	210,483,315	257,091,403	221,026,621	243,057,067	277,005,211

[a] Average, 1902-1905.
[b] Preliminary.
[c] Not including free ports prior to March 1, 1906.
[d] Year preceding.

WHEAT.

Wheat crop of countries named, 1903–1907.

Country.	1903.	1904.	1905.	1906.	1907.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	637,822,000	552,400,000	692,979,000	735,261,000	634,087,000
Canada:					
New Brunswick	471,000	371,000	418,000	420,000	424,000
Ontario	22,583,000	13,030,000	22,195,000	22,806,000	18,587,000
Manitoba	41,381,000	40,397,000	57,519,000	63,181,000	40,939,000
Saskatchewan	15,598,000	16,447,000	26,930,000	38,207,000	28,564,000
Alberta	1,238,000	968,000	2,379,000	4,091,000	4,092,000
Other	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000
Total Canada	85,271,000	75,213,000	113,441,000	132,705,000	96,606,000
Mexico	10,493,000	9,393,000	7,000,000	7,000,000	10,000,000
Total North America	733,586,000	637,006,000	813,420,000	874,966,000	740,693,000
SOUTH AMERICA.					
Argentina	103,759,000	129,672,000	150,745,000	134,931,000	155,993,000
Chile	10,114,000	17,948,000	12,089,000	12,157,000	15,776,000
Uruguay	5,240,000	7,565,000	7,000,000	4,606,000	6,867,000
Total South America	119,113,000	155,185,000	169,834,000	151,694,000	178,636,000
EUROPE.					
Austria-Hungary:					
Austria	46,198,000	53,734,000	54,531,000	58,255,000	52,069,000
Hungary proper	161,958,000	137,078,000	157,514,000	197,408,000	120,508,000
Croatia-Slavonia	14,664,000	9,841,000	13,077,000	10,314,000	10,200,000
Bosnia-Herzegovina	3,901,000	3,753,000	3,016,000	2,698,000	2,282,000
Total Austria-Hungary	226,721,000	204,406,000	228,138,000	268,675,000	185,059,000
Belgium	12,350,000	13,817,000	12,401,000	12,964,000	12,000,000
Bulgaria	35,551,000	42,242,000	40,736,000	55,076,000	30,000,000
Denmark	4,461,000	4,302,000	4,083,000	4,161,000	4,000,000
Finland	130,000	133,000	129,000	100,000	100,000
France	364,320,000	298,826,000	335,453,000	324,919,000	369,970,000
Germany	130,626,000	139,803,000	135,947,000	144,754,000	127,843,000
Greece	8,000,000	8,000,000	8,000,000	8,000,000	8,000,000
Italy	184,451,000	167,635,000	160,504,000	176,464,000	177,543,000
Montenegro	200,000	200,000	200,000	200,000	200,000
Netherlands	4,258,000	4,423,000	5,109,000	4,978,000	5,000,000
Norway	307,000	212,000	329,000	303,000	200,000
Portugal	8,000,000	9,000,000	5,000,000	9,000,000	6,000,000
Roumania	73,700,000	53,738,000	103,328,000	113,867,000	42,237,000
Russia:					
Russia proper	454,596,000	519,964,000	451,327,000	344,765,000	....
Poland	19,255,000	21,241,000	20,239,000	21,152,000	....
Northern Caucasia	77,877,000	81,050,000	96,708,000	85,046,000	....
Total Russia (European)	551,728,000	622,255,000	568,274,000	450,963,000	455,000,000
Servia	10,885,000	11,676,000	11,280,000	13,211,000	8,375,000
Spain	128,979,000	95,377,000	92,504,000	140,656,000	100,331,000
Sweden	5,538,000	5,135,000	5,529,000	6,650,000	5,953,000
Switzerland	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000
Turkey (European)	26,000,000	23,000,000	20,000,000	25,000,000	16,000,000
United Kingdom:					
Great Britain—					
England	46,524,000	35,624,000	57,424,000	57,583,000	53,860,000
Scotland	1,528,000	1,499,000	2,130,000	2,063,000	1,951,000
Wales	1,093,000	919,000	1,204,000	1,308,000	1,139,000
Ireland	1,176,000	1,040,000	1,430,000	1,527,000	1,325,000
Total United Kingdom	50,321,000	39,082,000	62,188,000	62,481,000	58,275,000
Total Europe	1,830,526,000	1,747,262,000	1,803,132,000	1,826,422,000	1,616,086,000

Wheat crop of countries named, 1903-1907—Continued.

Country.	1903.	1904.	1905.	1906.	1907.
ASIA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
British India, including such native States as report	297,601,000	359,936,000	283,063,000	320,288,000	315,386,000
Cyprus	2,477,000	2,176,000	2,441,000	2,410,000	2,000,000
Japanese Empire:					
Japan	9,600,000	19,754,000	18,437,000	20,283,000	22,932,000
Formosa	179,000	190,000	200,000	178,000	200,000
Total Japanese Empire	9,779,000	19,944,000	18,637,000	20,461,000	23,132,000
Persia	16,000,000	16,000,000	16,000,000	16,000,000	16,000,000
Russia:					
Central Asia	20,925,000	12,822,000	25,491,000	11,486,000	....
Siberia	48,670,000	31,590,000	42,411,000	45,833,000	....
Transcaucasia [a]	64,000	82,000	109,000	108,000	....
Total Russia (Asiatic)	69,659,000	44,494,000	68,011,000	57,427,000	56,000,000
Turkey (Asiatic)	35,000,000	35,000,000	35,000,000	35,000,000	35,000,000
Total Asia	430,516,000	477,550,000	423,152,000	451,586,000	447,518,000
AFRICA.					
Algeria	34,035,000	25,484,000	25,579,000	34,080,000	31,120,000
Cape of Good Hope	1,755,000	2,000,000	2,000,000	2,000,000	2,000,000
Egypt	12,000,000	12,000,000	12,000,000	12,000,000	12,000,000
Natal	4,000	7,000	4,000	8,000	6,000
Sudan (Anglo-Egyptian)	294,000	486,000	483,000	542,000	500,000
Tunis	7,523,000	10,519,000	5,729,000	4,409,000	6,000,000
Total Africa	55,611,000	50,496,000	45,795,000	53,039,000	51,626,000
AUSTRALASIA.					
Australia:					
Queensland	6,000	2,514,000	2,217,000	1,173,000	1,144,000
New South Wales	1,635,000	28,196,000	16,983,000	21,391,000	22,506,000
Victoria	2,650,000	29,425,000	21,666,000	24,156,000	23,331,000
South Australia	6,555,000	13,626,000	12,454,000	20,779,000	17,686,000
Western Australia	1,017,000	1,935,000	2,077,000	2,381,000	2,846,000
Tasmania	905,000	792,000	818,000	801,000	672,000
Total Australia	12,768,000	76,488,000	56,215,000	70,681,000	68,185,000
New Zealand	7,693,000	8,140,000	9,411,000	7,013,000	5,782,000
Total Australasia	20,461,000	84,628,000	65,626,000	77,694,000	73,967,000
Grand total	3,189,813,000	3,152,127,000	3,320,959,000	3,435,401,000	3,108,526,000

[a] Includes Chernomorsk only.

Acreage, production, value, prices, and exports of wheat in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Chicago cash price per bushel, No. 1, northern.				Domestic exports, including flour, fiscal year beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1850 *a*	....	....	100,485,944	....	....	....	....	....	....	....
1860 *a*	....	....	173,104,924	....	....	....	....	....	....	....
1866	15,424,496	9.9	151,999,906	152.7	232,109,630	129	145	185	211	12,646,941
1867	18,321,561	11.6	212,441,400	145.2	308,387,146	126	140	134	161	25,284,803
1868	18,460,132	12.1	224,036,600	108.5	243,032,746	80	88	87	96	29,717,201
1869	19,181,004	13.6	260,146,900	76.5	199,024,996	63	76	79	92	53,900,780
1870	18,992,591	12.4	235,884,700	94.4	222,766,969	91	98	113	120	52,580,111
1871	19,943,893	11.6	230,722,400	114.5	264,075,851	107	111	120	143	38,995,755
1872	20,858,359	11.9	249,997,100	111.4	278,522,068	97	108	112	122	52,014,715
1873	22,171,676	12.7	281,254,700	106.9	300,669,528	96	106	105	114	91,510,398
1874	24,967,027	12.3	308,102,700	86.3	265,881,167	78	83	78	94	72,912,817
1875	26,381,512	11.1	292,136,000	89.5	261,396,926	82	91	89	100	74,750,682
1876	27,627,021	10.5	289,356,500	96.3	278,697,238	104	117	130	172	57,043,936
1877	26,277,546	13.9	364,194,146	105.7	385,089,444	103	108	98	113	92,071,726
1878	32,108,560	13.1	420,122,400	77.6	325,814,119	81	84	91	102	150,502,506
1879	32,545,950	13.8	448,756,630	110.8	497,030,142	122	133½	112½	119	180,304,180
1880	37,986,717	13.1	498,549,868	95.1	474,201,850	93½	109¾	101	112⅝	186,321,514
1881	37,709,020	10.2	383,280,090	119.2	456,880,427	124¾	129	123	140	121,892,389
1882	37,067,194	13.6	504,185,470	88.4	445,602,125	91⅛	94¾	108	113⅜	147,811,316
1883	36,455,593	11.6	421,086,160	91.1	383,649,272	94⅝	99¼	85	94¾	111,534,182
1884	39,475,885	13.0	512,765,000	64.5	330,862,260	69½	76⅜	85⅜	90¾	132,570,366
1885	34,189,246	10.4	357,112,000	77.1	275,320,390	82⅞	89	72⅛	79	94,565,793
1886	36,806,184	12.4	457,218,000	68.7	314,226,020	75⅛	79½	80¾	88¾	153,804,969
1887	37,641,783	12.1	456,329,000	68.1	310,612,960	75⅛	79¼	81¼	89⅞	119,625,344
1888	37,336,138	11.1	415,868,000	92.6	385,248,030	96⅝	105½	77¼	95½	88,600,742
1889	38,123,859	12.9	490,560,000	69.8	342,491,707	76¾	80½	89¾	100	109,430,467
1890	36,087,154	11.1	399,262,000	83.8	334,773,678	87½	92¾	98⅞	108¼	106,181,316
1891	39,916,897	15.3	611,780,000	83.9	513,472,711	89⅜	93¼	80	85¾	225,665,812
1892	38,554,430	13.4	515,949,000	62.4	322,111,881	69½	73	68¼	76¼	191,912,635
1893	34,629,418	11.4	396,131,725	53.8	213,171,381	59⅛	64½	52⅛	60½	164,283,129
1894	34,882,436	13.2	460,267,416	49.1	225,902,025	52¾	63⅝	60¾	85⅜	144,812,718
1895	34,047,332	13.7	467,102,947	50.9	237,938,998	53¾	64¾	57⅞	67⅝	126,443,968
1896	34,618,646	12.4	427,684,346	72.6	310,602,539	74⅝	93⅛	68¾	97⅞	145,124,972
1897	39,465,066	13.4	530,149,168	80.8	428,547,121	92	109	117	185	217,306,005
1898	44,055,278	15.3	675,148,705	58.2	392,770,320	62¾	70	68⅜	79½	222,618,420
1899	44,592,516	12.3	547,303,846	58.4	319,545,259	64	69½	63⅝	67½	186,096,762
1900	42,495,385	12.3	522,229,505	61.9	323,515,177	69¼	74⅝	70	75⅛	215,990,073
1901	49,895,514	15.0	748,460,218	62.4	467,350,156	73	79½	72⅜	76¼	234,772,516
1902	46,202,424	14.5	670,063,008	63.0	422,224,117	71⅞	77¾	74¾	80⅝	202,905,598
1903	49,464,967	12.9	637,821,835	69.5	443,024,826	77¾	87	87¾	101½	120,727,613
1904	44,074,875	12.5	552,399,517	92.4	510,489,874	115	122	89½	113¾	44,112,910
1905	47,854,079	14.5	692,979,489	74.8	518,372,727	82½	90	80¼	87¼	97,609,007
1906	47,305,829	15.5	735,260,970	66.7	490,332,760	*b* 72⅝	*b* 75	84	106	146,700,425
1907	45,211,000	14.0	634,087,000	87.4	554,437,000	*b* 92⅜	*b* 101⅛	*b* 98⅝	*b* 111	....

a Census figures. *b* No. 2, red winter.

Condition of the wheat crop in the United States, monthly, 1888–1908.

Year.	December of previous year.	Winter wheat.					Spring wheat.			
		April.	May.	June.	July.	When harvested.	June.	July.	August.	When harvested.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1888	95.9	82.0	73.1	73.3	75.6	77.4	92.8	95.9	87.3	77.2
1889	96.8	94.0	96.0	93.1	92.0	89.4	94.4	83.3	81.2	83.8
1890	95.3	81.0	80.0	78.1	76.2	73.5	91.3	94.4	83.2	79.8
1891	98.4	96.9	97.9	96.6	96.2	96.7	92.6	94.1	95.5	97.2
1892	85.3	81.2	84.0	88.3	89.6	87.6	92.3	90.9	87.3	81.2
1893	87.4	77.4	75.3	75.5	77.7	*a* 74.0	86.4	74.1	67.0	....
1894	91.5	86.7	81.4	83.2	83.9	*a* 83.7	88.0	68.4	67.1	....
1895	89.0	81.4	82.9	71.1	65.8	*a* 75.4	97.8	102.2	95.9	....
1896	81.4	77.1	82.7	77.9	75.6	*a* 74.6	99.9	93.3	78.9	....
1897	99.5	81.4	80.2	78.5	81.2	*a* 85.7	89.6	91.2	86.7	....
1898	....	86.7	86.5	90.8	85.7	*a* 86.7	100.9	95.0	96.5	....
1899	92.6	77.9	76.2	67.3	65.6	*a* 70.9	91.4	91.7	83.6	....
1900	97.1	82.1	88.9	82.7	80.8	*a* 69.6	87.3	55.2	56.4	....
1901	97.1	91.7	94.1	87.8	88.3	*a* 82.8	92.0	95.6	80.3	....
1902	86.7	78.7	76.4	76.1	77.0	*a* 80.0	95.4	92.4	89.7	....
1903	99.7	97.3	92.6	82.2	78.8	*a* 74.7	95.9	82.5	77.1	....
1904	86.6	76.5	76.5	77.7	78.7	....	93.4	93.7	87.5	66.2
1905	82.9	91.6	92.5	85.5	82.7	....	93.7	91.0	89.2	87.3
1906	94.1	89.1	90.9	82.7	85.6	....	93.4	91.4	86.9	83.4
1907	94.1	89.9	82.9	77.4	78.3	....	88.7	87.2	79.4	77.1
1908	91.1	91.3	89.0	....	....	....	....	....	....	....

a Includes both winter and spring.

Acreage, production, value, and distribution of wheat in the United States in 1907, by States.

State or Territory.	Crop of 1907.			Stock in farmers' hands Mar. 1, 1908.		Shipped out of county where grown.
	Acreage.	Production.	Farm value Dec. 1.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	8,000	210,000	212,000	71,000	34	0
Vermont	1,000	23,000	23,000	8,000	33	0
New York	416,000	7,197,000	7,125,000	1,799,000	25	1,295,000
New Jersey	108,000	1,998,000	1,958,000	559,000	28	480,000
Pennsylvania	1,618,000	30,095,000	28,891,000	11,436,000	38	9,028,000
Delaware	120,000	2,460,000	2,386,000	713,000	29	1,353,000
Maryland	777,000	14,763,000	14,172,000	3,395,000	23	9,596,000
Virginia	655,000	8,188,000	8,024,000	2,375,000	29	3,030,000
West Virginia	367,000	4,477,000	4,477,000	1,433,000	32	761,000
North Carolina	560,000	5,320,000	5,692,000	1,702,000	32	319,000
South Carolina	314,000	2,669,000	3,203,000	560,000	21	53,000
Georgia	297,000	2,673,000	3,074,000	535,000	20	107,000
Ohio	1,882,000	30,677,000	28,223,000	9,510,000	31	13,498,000
Indiana	2,362,000	34,013,000	29,931,000	8,163,000	24	18,707,000
Illinois	2,228,000	40,104,000	34,890,000	8,823,000	22	23,260,000
Michigan	878,000	12,731,000	11,585,000	3,310,000	26	4,838,000
Wisconsin	210,000	2,955,000	2,719,000	886,000	30	325,000
Minnesota	5,200,000	67,600,000	62,192,000	16,900,000	25	43,940,000
Iowa	569,000	7,653,000	6,276,000	2,449,000	32	2,449,000
Missouri	2,213,000	29,212,000	24,538,000	6,427,000	22	15,190,000
North Dakota	5,513,000	55,130,000	47,963,000	11,577,000	21	45,207,000
South Dakota	2,900,000	32,480,000	28,907,000	7,470,000	23	24,360,000
Nebraska	2,535,000	45,911,000	36,270,000	11,937,000	26	31,219,000
Kansas	5,959,000	65,609,000	53,799,000	13,122,000	20	46,582,000
Kentucky	734,000	8,808,000	8,103,000	1,762,000	20	2,819,000
Tennessee	779,000	7,400,000	7,030,000	1,554,000	21	2,368,000
Alabama	89,000	890,000	935,000	160,000	18	18,000
Mississippi	2,000	22,000	19,000	3,000	14	0
Texas	380,000	2,812,000	2,784,000	197,000	7	422,000
Oklahoma	959,000	8,631,000	7,164,000	1,295,000	15	5,265,000
Arkansas	154,000	1,463,000	1,390,000	322,000	22	59,000
Montana	139,000	4,003,000	3,243,000	1,281,000	32	1,201,000
Wyoming	30,000	855,000	658,000	265,000	31	51,000
Colorado	293,000	8,497,000	6,628,000	2,039,000	24	4,418,000
New Mexico	46,000	1,104,000	1,027,000	232,000	21	83,000
Arizona	15,000	388,000	403,000	62,000	16	27,000
Utah	161,000	4,637,000	3,431,000	1,716,000	37	1,623,000
Nevada	30,000	960,000	998,000	202,000	21	144,000
Idaho	342,000	8,639,000	5,788,000	1,814,000	21	5,356,000
Washington	1,349,000	35,045,000	26,284,000	5,958,000	17	26,985,000
Oregon	651,000	15,265,000	11,907,000	2,442,000	16	8,854,000
California	1,368,000	20,520,000	20,110,000	2,257,000	11	12,312,000
United States	45,211,000	634,087,000	554,437,000	143,721,000	23.5	367,607,000

Acreage, production, and farm value December 1 of winter and spring wheat in the United States in 1907.

State or Territory.	Winter wheat.					Spring wheat.				
	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*	*Acres.*	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*
Maine						8,000	26.2	210,000	101	212,000
Vermont						1,000	23.0	23,000	100	23,000
New York	416,000	17.3	7,197,000	99	7,125,000					
New Jersey	108,000	18.5	1,998,000	98	1,958,000					
Pennsylvania	1,618,000	18.6	30,095,000	96	28,891,000					
Delaware	120,000	20.5	2,460,000	97	2,386,000					
Maryland	777,000	19.0	14,763,000	96	14,172,000					
Virginia	655,000	12.5	8,188,000	98	8,024,000					
West Virginia	367,000	12.2	4,477,000	100	4,477,000					
North Carolina	560,000	9.5	5,320,000	107	5,692,000					
South Carolina	314,000	8.5	2,669,000	120	3,203,000					
Georgia	297,000	9.0	2,673,000	115	3,074,000					
Ohio	1,882,000	16.3	30,677,000	92	28,223,000					
Indiana	2,362,000	14.4	34,013,000	88	29,931,000					
Illinois	2,228,000	18.0	40,104,000	87	34,890,000					
Michigan	878,000	14.5	12,731,000	91	11,585,000					
Wisconsin	60,000	15.5	930,000	92	856,000	150,000	13.5	2,025,000	92	1,863,000
Minnesota						5,200,000	13.0	67,600,000	92	62,192,000
Iowa	65,000	18.5	1,202,000	82	986,000	504,000	12.8	6,451,000	82	5,290,000
Missouri	2,213,000	13.2	29,212,000	84	24,538,000					
North Dakota						5,513,000	10.0	55,130,000	87	47,963,000
South Dakota						2,900,000	11.2	32,480,000	89	28,907,000
Nebraska	2,213,000	19.0	42,047,000	79	33,217,000	322,000	12.0	3,864,000	79	3,053,000
Kansas	5,645,000	11.3	63,788,000	82	52,306,000	314,000	5.8	1,821,000	82	1,493,000
Kentucky	734,000	12.0	8,808,000	92	8,103,000					
Tennessee	779,000	9.5	7,400,000	95	7,030,000					
Alabama	89,000	10.0	890,000	105	935,000					
Mississippi	2,000	11.0	22,000	88	19,000					
Texas	380,000	7.4	2,812,000	99	2,784,000					
Oklahoma	959,000	9.0	8,631,000	83	7,164,000					
Arkansas	154,000	9.5	1,463,000	95	1,390,000					
Montana						139,000	28.8	4,003,000	81	3,243,000
Wyoming						30,000	28.5	855,000	77	658,000
Colorado						293,000	29.0	8,497,000	78	6,628,000
New Mexico						46,000	24.0	1,104,000	93	1,027,000
Arizona						15,000	25.9	388,000	105	408,000
Utah						161,000	28.8	4,637,000	74	3,431,000
Nevada						30,000	32.0	960,000	104	998,000
Idaho	173,000	26.0	4,498,000	67	3,014,000	169,000	24.5	4,141,000	67	2,774,000
Washington	399,000	29.5	11,770,000	75	8,828,000	950,000	24.5	23,275,000	75	17,456,000
Oregon	317,000	25.5	8,084,000	78	6,306,000	334,000	21.5	7,181,000	78	5,601,000
California	1,368,000	15.0	20,520,000	98	20,110,000					
United States	28,132,000	14.6	409,442,000	88.2	361,217,000	17,079,000	13.2	224,645,000	86.0	193,220,000

Average yield of wheat in countries named, bushels per acre, 1897–1906.

Year.	United States.[a]	Russia, European.[b]	Germany.[b]	Austria.[b]	Hungary proper.[b]	France.[a]	United Kingdom.[a]
1897	13.4	6.8	25.3	13.2	11.7	15.1	30.0
1898	15.3	9.6	27.2	18.0	17.1	21.1	35.8
1899	12.3	8.7	28.4	19.0	17.8	21.2	33.8
1900	12.3	8.3	27.9	15.5	16.9	19.2	29.5
1901	15.0	8.1	23.5	16.7	15.1	18.5	31.9
1902	14.5	11.1	30.3	19.0	20.7	20.2	33.9
1903	12.9	10.6	29.2	17.8	19.0	22.8	31.1
1904	12.5	11.5	29.5	19.5	16.3	19.3	27.8
1905	14.5	10.0	28.5	19.6	18.7	20.8	33.9
1906	15.5	7.7	30.3	20.2	22.5	20.2	34.7
Average	13.8	9.2	28.0	17.8	17.6	19.8	32.2

[a] Winchester bushels. [b] Bushels of 60 pounds.

Average yield per acre of wheat in the United States, 1898–1907, by States

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	19.5	22.5	19.5	23.9	25.3	25.5	23.3	23.0	24.8	26.2
New Hampshire	19.0	17.2	16.3	......	......	......	......	......	......	......
Vermont	22.5	22.0	23.5	18.7	18.8	20.9	25.1	18.8	22.3	23.0
Connecticut	20.0	18.3	20.8	......	......	......	......	......	......	......
New York	21.2	18.5	17.7	13.1	16.8	17.8	11.3	21.0	20.0	17.3
New Jersey	17.4	14.5	19.1	16.8	16.0	14.0	13.3	16.4	18.3	18.5
Pennsylvania	17.5	13.6	13.5	17.1	15.8	15.6	14.1	17.1	17.7	18.6
Delaware	13.3	12.8	20.3	18.5	16.5	10.2	14.9	13.8	16.0	20.5
Maryland	15.3	14.1	19.5	17.2	14.7	12.5	13.4	16.3	16.0	19.0
Virginia	14.1	8.4	11.9	10.9	5.7	8.7	10.2	11.4	12.5	12.5
West Virginia	13.8	9.3	9.8	10.9	7.7	10.2	10.1	12.3	12.7	12.2
North Carolina	9.2	6.7	9.6	8.7	5.3	5.1	8.6	6.7	9.1	9.5
South Carolina	10.6	6.5	9.0	8.8	5.6	6.5	8.1	6.1	9.3	8.5
Georgia	10.0	6.8	9.1	8.2	6.0	6.2	8.8	6.9	10.0	9.0
Ohio	16.9	14.2	6.0	15.3	17.1	13.7	11.5	17.1	20.4	16.3
Indiana	15.6	9.8	5.3	15.8	16.0	10.0	9.2	18.3	20.7	14.4
Illinois	11.0	10.0	13.0	17.6	17.9	8.4	13.8	16.0	19.5	18.0
Michigan	20.8	8.4	7.6	11.1	17.7	15.5	9.8	18.5	13.1	14.5
Wisconsin	18.0	15.5	15.5	16.1	18.1	15.6	15.5	16.6	16.3	14.1
Minnesota	15.8	13.4	10.5	12.9	13.9	13.1	12.8	13.3	10.9	13.0
Iowa	16.7	13.0	15.6	16.2	12.7	12.4	11.6	14.2	15.7	13.4
Missouri	9.8	9.9	12.5	15.9	19.9	8.7	17.7	12.4	14.8	13.2
North Dakota	14.4	12.8	4.9	13.1	15.9	12.7	11.8	14.0	13.0	10.0
South Dakota	12.4	10.7	6.9	12.9	12.2	13.8	9.6	13.7	13.4	11.2
Nebraska	16.4	10.3	12.0	17.1	20.9	15.7	13.6	19.4	22.0	18.1
Kansas	14.2	9.8	17.7	18.5	10.4	14.1	12.4	13.9	15.1	11.0
Kentucky	15.4	9.1	13.0	12.1	9.3	8.4	11.4	11.3	14.1	12.0
Tennessee	13.2	8.7	9.9	10.8	7.2	7.1	11.5	7.2	12.5	9.5
Alabama	12.0	7.6	9.5	8.7	6.0	9.1	10.3	9.6	11.0	10.0
Mississippi	13.9	7.7	9.6	8.8	8.0	8.0	8.8	10.8	10.0	11.0
Texas	14.8	11.1	18.4	8.9	9.0	13.4	10.7	8.9	11.5	7.4
Indian Territory	......	......	......	12.2	12.3	12.0	14.1	10.0	12.0	9.0
Oklahoma	14.9	13.3	19.0	16.4	11.1	14.9	11.7	8.2	14.0	
Arkansas	11.0	8.6	10.1	8.8	9.1	7.0	10.1	7.9	10.8	9.5
Montana	29.5	25.7	26.6	26.5	26.0	28.2	23.9	23.8	24.0	28.8
Wyoming	23.7	18.8	17.6	24.5	23.5	20.9	22.1	25.4	28.7	28.5
Colorado	26.3	23.7	22.6	24.1	18.0	26.6	22.8	25.0	32.5	29.0
New Mexico	23.8	13.8	21.0	21.5	17.1	18.4	12.8	22.2	25.0	24.0
Arizona	31.7	15.3	14.6	21.8	18.7	25.3	25.5	24.4	25.2	25.9
Utah	28.0	20.7	20.9	20.5	21.2	22.6	26.6	26.4	27.4	28.8
Nevada	29.0	18.0	24.5	25.1	27.1	27.6	26.2	27.0	31.5	32.0
Idaho	31.0	24.2	20.8	21.2	22.1	21.1	22.9	28.2	24.4	25.3
Washington	24.2	22.7	23.5	29.1	22.2	20.3	22.2	24.6	20.8	26.0
Oregon	20.5	19.2	13.8	21.1	20.0	18.2	19.0	18.6	20.0	23.4
California	9.1	14.1	10.3	13.0	10.9	11.2	10.8	9.3	17.1	15.0
General average	15.3	12.3	12.3	15.0	14.5	12.9	12.5	14.5	15.5	14.0

Average farm value per acre of wheat in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$17.36	$20.47	$17.55	$23.18	$23.28	$24.99	$24.23	$24.38	$25.05	$26.50
New Hampshire	17.48	16.34	15.00	......	......	......	......	......	......	......
Vermont	20.25	18.70	18.33	17.58	20.49	19.85	28.36	16.92	19.18	23.00
Connecticut	17.60	17.39	17.05	......	......	......	......	......	......	......
New York	15.26	14.80	13.63	10.74	13.27	14.42	12.32	18.06	16.40	17.13
New Jersey	12.70	10.88	14.13	12.10	12.16	11.48	14.63	14.43	14.64	18.13
Pennsylvania	11.90	8.98	9.72	12.31	11.53	12.32	15.23	14.88	13.45	17.86
Delaware	9.18	8.70	14.21	13.13	12.38	7.96	16.09	11.32	11.36	19.88
Maryland	10.71	9.59	13.84	12.21	10.58	9.88	14.20	13.37	11.36	18.24
Virginia	9.31	5.80	8.57	7.96	4.50	7.31	11.12	10.03	10.12	12.25
West Virginia	9.80	6.60	7.55	8.39	6.31	8.67	11.01	10.95	10.29	12.20
North Carolina	7.18	5.49	7.87	7.13	4.88	4.95	10.23	6.83	8.46	10.16
South Carolina	9.96	6.44	9.09	8.62	5.71	6.56	10.21	6.77	10.23	10.20
Georgia	9.80	6.66	8.64	7.71	5.88	5.95	11.09	7.38	10.20	10.35
Ohio	11.15	9.09	4.26	10.86	12.14	10.96	12.65	14.02	14.48	15.00
Indiana	9.83	6.27	3.71	11.06	10.88	7.80	9.75	15.01	14.49	12.67
Illinois	6.60	6.30	8.32	12.14	10.56	6.30	13.94	12.96	13.46	15.66
Michigan	13.31	5.46	5.24	7.88	12.21	11.94	10.58	14.61	9.43	13.19
Wisconsin	10.62	9.46	9.92	10.48	11.61	11.22	15.18	12.65	11.73	12.95
Minnesota	8.53	7.37	6.62	7.74	8.48	9.04	11.14	9.44	7.08	11.96
Iowa	8.68	7.15	9.20	9.75	6.96	7.69	10.48	10.08	10.07	11.03
Missouri	5.78	6.14	7.88	10.97	11.54	6.18	11.23	9.80	9.92	11.09
North Dakota	7.34	6.53	2.84	7.07	9.22	8.00	9.56	9.66	8.19	8.70
South Dakota	6.20	5.35	4.00	6.84	6.95	8.56	7.58	9.18	8.17	9.97
Nebraska	7.71	5.05	6.36	9.23	10.23	8.47	11.83	12.81	12.54	14.31
Kansas	7.10	5.10	9.73	10.92	5.73	8.33	11.06	9.88	8.75	9.03
Kentucky	9.55	6.01	8.97	8.71	6.88	6.80	12.43	9.83	10.29	11.04
Tennessee	8.84	6.79	7.82	7.99	5.47	5.96	12.77	6.55	9.75	9.02
Alabama	10.80	6.76	8.45	7.66	5.58	8.65	11.85	9.70	10.34	10.51
Mississippi	11.54	6.01	8.06	7.57	6.80	7.44	8.89	10.26	8.70	9.50
Texas	10.06	7.55	11.78	6.94	6.93	10.45	11.77	7.83	8.85	7.33
Indian Territory	......	......	......	8.42	7.50	8.28	13.82	7.70	7.44	7.47
Oklahoma	7.75	7.05	10.07	10.33	6.44	9.39	10.88	5.66	7.70	
Arkansas	6.38	5.50	6.57	6.86	6.10	5.46	10.20	7.11	8.10	9.03
Montana	17.11	15.68	16.23	17.76	16.12	18.61	21.28	16.90	15.36	23.33
Wyoming	16.35	12.60	13.38	16.91	19.04	15.47	19.89	18.29	20.95	21.93
Colorado	14.73	13.51	13.33	16.15	13.50	17.56	22.75	17.50	21.13	22.62
New Mexico	14.76	8.42	14.28	15.48	14.71	13.80	13.57	19.98	20.75	22.33
Arizona	29.16	9.79	11.53	18.53	19.64	23.53	28.82	26.21	25.96	27.20
Utah	15.12	10.97	11.49	14.35	16.11	18.08	22.88	17.69	17.81	21.31
Nevada	27.55	13.68	17.15	22.09	25.56	27.32	24.10	20.79	26.77	33.27
Idaho	15.81	12.10	9.57	12.93	15.44	15.86	18.34	18.49	14.66	16.92
Washington	13.07	11.58	11.99	13.67	14.44	14.04	17.77	16.13	12.91	19.48
Oregon	12.71	10.18	7.59	11.37	13.37	13.98	15.37	12.68	13.26	18.29
California	6.55	8.74	5.97	7.80	8.72	9.74	9.50	7.63	12.82	14.70
General average	8.92	7.17	7.61	9.37	9.14	8.96	11.58	10.83	10.37	12.26

Average farm price of wheat per bushel in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$0.89	$0.91	$0.90	$0.97	$0.92	$0.98	$1.04	$1.06	$1.01	$1.01
New Hampshire	.92	.95	.92	......	......	......	......	......	......	......
Vermont	.90	.85	.78	.94	1.09	.95	1.13	.90	.86	1.00
Connecticut	.88	.95	.82	......	......	......	......	......	......	......
New York	.72	.80	.77	.82	.79	.81	1.09	.86	.82	.99
New Jersey	.73	.75	.74	.72	.76	.82	1.10	.88	.80	.98
Pennsylvania	.68	.66	.72	.72	.73	.79	1.08	.87	.76	.96
Delaware	.69	.68	.70	.71	.75	.78	1.08	.82	.71	.97
Maryland	.70	.68	.71	.71	.72	.79	1.06	.82	.71	.96
Virginia	.66	.69	.72	.73	.79	.84	1.09	.88	.81	.98
West Virginia	.71	.71	.77	.77	.82	.85	1.09	.89	.81	1.00
North Carolina	.78	.82	.82	.82	.92	.97	1.19	1.02	.93	1.07
South Carolina	.94	.99	1.01	.98	1.02	1.01	1.26	1.11	1.10	1.20
Georgia	.98	.98	.95	.94	.98	.96	1.26	1.07	1.02	1.15
Ohio	.66	.64	.71	.71	.71	.80	1.10	.82	.71	.92
Indiana	.63	.64	.70	.70	.68	.78	1.06	.82	.70	.88
Illinois	.60	.63	.64	.69	.59	.75	1.01	.81	.69	.87
Michigan	.64	.65	.69	.71	.69	.77	1.08	.79	.72	.91
Wisconsin	.59	.61	.64	.65	.64	.72	.98	.76	.72	.92
Minnesota	.54	.55	.63	.60	.61	.69	.87	.71	.65	.92
Iowa	.52	.55	.59	.60	.55	.62	.90	.71	.64	.82
Missouri	.59	.62	.63	.69	.58	.71	.96	.79	.67	.84
North Dakota	.51	.51	.58	.54	.58	.63	.81	.69	.63	.87
South Dakota	.50	.50	.58	.53	.57	.62	.79	.67	.61	.89
Nebraska	.47	.49	.53	.54	.49	.54	.87	.66	.57	.79
Kansas	.50	.52	.55	.59	.55	.59	.89	.71	.58	.82
Kentucky	.62	.66	.69	.72	.74	.81	1.09	.87	.73	.92
Tennessee	.67	.78	.79	.74	.76	.84	1.11	.91	.78	.95
Alabama	.90	.89	.89	.88	.93	.95	1.15	1.01	.94	1.05
Mississippi	.83	.78	.84	.86	.85	.93	1.01	.95	.87	.88
Texas	.68	.68	.64	.78	.77	.78	1.10	.88	.77	.99
Indian Territory	......	......	......	.69	.61	.69	.98	.77	.62	.83
Oklahoma	.52	.53	.53	.63	.58	.63	.93	.69	.55	
Arkansas	.58	.64	.65	.78	.67	.78	1.01	.90	.75	.95
Montana	.58	.61	.61	.67	.62	.66	.89	.71	.64	.81
Wyoming	.69	.67	.76	.69	.81	.74	.90	.72	.73	.77
Colorado	.56	.57	.59	.67	.75	.66	.91	.70	.65	.78
New Mexico	.62	.61	.68	.72	.86	.75	1.06	.90	.83	.93
Arizona	.92	.64	.79	.85	1.05	.93	1.13	1.17	1.03	1.05
Utah	.54	.53	.55	.70	.76	.80	.86	.67	.65	.74
Nevada	.95	.76	.70	.88	.98	.99	.92	.77	.85	1.04
Idaho	.51	.50	.46	.61	.70	.75	.80	.66	.60	.67
Washington	.54	.51	.51	.47	.65	.69	.80	.65	.62	.75
Oregon	.62	.53	.55	.54	.67	.77	.81	.68	.66	.78
California	.72	.62	.58	.60	.80	.87	.88	.82	.75	.98
General average	.582	.584	.619	.624	.630	.695	.924	.748	.667	.874

Wholesale prices of wheat per bushel, 1902–1907.

Date.	New York.		Baltimore.		Chicago.		Detroit.		St. Louis.		Minneapolis.		San Francisco.	
	No. 2, red winter.		Southern, No. 2, red.		No. 1, northern spring.		No. 2, red.		No. 2, red winter.		No. 1, northern.		No. 1, California (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1902.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*		
January	85¾	94¼	81⅜	87½	74	80½	86	93½	86¼	92½	73⅝	79½	$1.05	$1.08¾
February	85⅞	93¼	80	85⅝	72⅞	76½	84¼	87½	83¼	89	72¼	75⅛	1.07½	1.12½
March	82	90⅜	76	85	69¾	76	77½	85¾	76⅜	86¾	70½	75⅛	1.10	1.12½
April	82	92½	75	85½	70	76¾	77½	87¼	77¼	83½	70⅝	77⅜	1.10	1.13¾
May	88¼	93¾	81	87½	72⅜	76¼	80	88	76½	84½	74	78	1.11¼	1.16¼
June	87⅜	93⅜	76	83	71¼	75¾	79	81½	70	80	73⅛	77½	1.11¼	1.13¾
July	76⅞	92¼	70¾	81¾	71½	79	72	82	65½	81	76⅜	80⅜	1.13¾	1.16¼
August	74⅞	78⅜	66¼	74¼	68¼	76	68½	73	63	68¼	74¼	79¾	1.12½	1.15
September	73½	77	68	72¾	70	95	70¾	74	66	68¾	66½	71¼	1.12½	1.20
October	73⅞	79	69	75½	67½	75½	72	76¾	67¾	72	68	73⅞	1.18¾	1.35
November	76	79⅞	71¼	77½	69⅞	77⅜	75½	80¾	69	71	71⅞	74½	1.32½	1.45
December	76⅛	80⅛	71¼	77	71⅞	77¾	77½	83	69	75	72¼	74⅞	1.37½	1.43¾

Wholesale prices of wheat per bushel, 1902–1907—Continued.

Date.	New York.		Baltimore.		Chicago.		Detroit.		St. Louis.		Minneapolis.		San Francisco.	
	No. 2, red winter.		Southern, No. 2, red.		No. 1, northern spring.		No. 2, red.		No. 2, red winter.		No. 1, northern.		No. 1, California (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*		
January	78¼	84⅝	77½	83	70¾	79¼	77¾	83½	73½	76½	73⅛	78⅛	$1.36¼	$1.50
February	81⅝	84	80	81	73¾	80½	79	81	73½	77½	75⅝	78	1.43¾	1.55
March	78½	83⅛	77¾	81	70¼	75⅞	74¼	79	70	75½	74⅜	77⅞	1.35	1.52½
April	79	86½	78¼	83	71⅝	79	75¼	77¾	69¾	73⅝	74⅞	77⅜	1.35	1.38¾
May	81¾	89⅝	79	82½	74¾	80⅝	76	79½	72	76½	76	80⅛	1.32½	1.40
June	85	87	78¼	82	74¼	85⅞	77¾	82	76	84	79½	88⅛	1.32½	1.40
July	80¼	89⅜	76½	81	75	84	76½	80	77½	84	83¼	89¼	1.32½	1.50
August	83¾	89⅞	79	83½	77¼	90¼	78½	84	79¼	85	83⅜	100	1.45	1.50
September	81¾	89½	78¼	83¼	79½	93	79	84¼	84	88	82	91¾	1.37½	1.47½
October	82⅛	91⅝	80½	86	76¾	88	82¾	87½	85	91	78¼	86	1.36¼	1.41¼
November	83¾	92⅜	82½	87	75¾	86¼	84	90	85½	90½	77⅜	82⅛	1.38¾	1.41½
December	89⅛	99⅞	85¾	88¾	77¾	87	89½	94	90	94	80½	83⅞	1.33¾	1.40
1904.														
January	92½	101	88¼	94	81¼	93½	92	95½	84½	97	84¾	91¼	1.35	1.40
February	94	115	94	112	86	110	94¼	112	94	112½	90	105	1.35	1.43¾
March	101	111	99	105¼	88¼	98⅜	97½	104½	98	108½	94½	101½	1.36¼	1.43¾
April	104	110½	98½	105	85½	96⅞	98	105	97	108	90⅜	98¾	1.27½	1.40
May	106	120	99½	108	87¾	101½	102½	112½	98	110	93½	98⅝	1.26¼	1.30
June	104	115½	82	103¼	92	100	101	113	100	110¾	93½	97½	1.23¾	1.30
July	100	116	82	89	94½	106½	97	107	91	112	94⅝	102	1.23¾	1.37½
August	100	120¾	88⅜	109¼	102	120	98	116	91	114¼	103½	124⅜	1.37½	1.46¼
September	108	125¼	103¼	114	116	122	111½	123	108½	121	112	124½	1.40	1.48¾
October	113½	126¼	113	118½	115	122	116	121	113½	121	111⅝	122	1.45	1.50
November	117¼	125¾	108½	115¼	115	120	116	122	112½	118	106⅜	119⅝	1.45	1.50
December	116	124¼	108¾	115	115	122	115	120	113	118	106⅛	114½	1.45	1.50
1905.														
January	118⅞	125¾	101¾	119½	118	121	119	123½	114	120	108½	113½	1.45	1.52½
February	120¼	125¼	101½	117½	115	124	117½	124	116½	119½	107¾	112¾	1.50	1.55
March	114⅛	121⅜	98	114½	112	118¾	107½	121	111	117	105	111⅞	1.50	1.55
April	91½	115	83	109½	88½	118	96	107½	98	112½	91⅝	108⅛	1.45	1.55
May	91½	111½	83½	107½	89½	113¾	97	108	98	113½	95⅝	124½	1.45	1.55
June	103⅜	114¼	73	103½	107⅜	120	100	109	92	107	104	109¼	1.50	1.55
July	90	109¼	75	92	112	120	86	105	83½	95½	101¼	109¼	1.50	1.55
August	84⅜	91⅛	76	84½	103	115	81	84	82½	88	83½	111	1.45	1.55
September	85⅝	91⅜	75¾	84½	88	95	82¼	85¾	82	90	75¼	80	1.40	1.55
October	88¼	99	76½	86½	86	92¼	80	90½	88	95	78⅜	87⅛	1.40	1.45
November	90	98¼	76	85¼	85	92	87¼	90½	89	95	79	84½	1.40	1.45
December	92¾	101	78	87	82½	90	86	89	90½	96½	77¾	81¾	1.35	1.45
1906.														
January	89½	97	84	86¾	81¼	85¼	85	88	92	96	81	84⅛	......	......
February	90⅜	96½	84½	86¾	79¼	83½	84	86½	88	95⅝	78½	83½	......	......
March	85	89¼	81	84¾	74½	79½	81	86	89	94	74⅞	78⅞	......	......
April	88¼	92¼	83	88¾	77½	83	85½	89	90	98	76⅝	81⅛	......	......
May	93	95	86¾	89½	80¼	87¼	89¼	93½	88	99¼	78⅜	84¾	......	......
June	91⅞	97	87¼	91	81⅝	85¾	86	89¼	86	95	82⅛	85⅜	......	......
July	81	92⅜	75¾	81¾	75¾	84	74¾	85½	71¾	82	76⅛	82	......	......
August	77¼	81½	71	75	73⅝	77⅞	72¼	75	68⅛	72½	73¼	77½	......	......
September	77	81	68	74⅛	77	79	72	75¼	69	76	69⅝	78⅜	......	......
October	78½	83⅛	74	75⅜	a71	a73¾	74¾	78¼	74	77½	74½	77⅝	......	......
November	80½	84¼	73½	75½	a71⅝	a74¼	77½	78½	74	76½	77⅜	82¾	......	......
December	80¼	83	73⅜	75	a72⅝	a75	76⅜	78¼	74	76½	77⅝	81⅜	......	......
1907.														
January	80	84	......	......	......	......	75	78¼	74½	79¼	76¾	83⅝	1.22½	1.40
February	83	85¾	......	......	82	87	77	79¼	76½	80	79¾	85⅛	1.25	1.35
March	80¾	85	......	......	79	86½	76	78¼	75½	79	78½	81½	1.25	1.40
April	82½	91	......	......	80	87	77¼	82½	75½	81½	79⅜	86⅛	1.27½	1.50
May	87	108⅞	......	......	84	106	81	103	80½	101	87	105⅜	1.35	1.55
June	94⅜	104⅜	......	......	98	105	93	99¼	90½	100	96⅞	104⅜	1.42½	1.55
July	96⅝	105⅜	......	......	100	106½	91¼	99	87½	96½	98	105¼	1.50	1.60
August	91	100⅝	......	......	93	105	83½	92¼	81	91	94¾	105⅛	1.50	1.60
September	100⅛	108¼	......	......	105	112	92¼	99	89½	101¼	104½	111½	1.55	1.70
October	104¾	116¼	......	......	108	122	97¾	106½	96	109½	103¼	119¾	1.60	1.77½
November	94¾	108½	......	......	......	......	94¼	100¼	90	99	98	107⅛	1.65	1.80
December	104¼	109	......	......	......	......	97¾	104¼	96	105	103¼	111¼	1.60	1.77½

a No. 2, red winter.

International trade in wheat, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Argentina	Jan. 1	23,696,306	61,778,175	84,684,087	105,391,256	82,599,397
Australia	Jan. 1	9,282,894	1,209,800	34,113,906	25,424,969	31,216,052
Austria-Hungary	Jan. 1	518,538	603,379	117,282	49,321	1,117,854
Belgium	Jan. 1	12,467,375	11,751,205	14,803,681	14,639,453	16,051,913
British India	Apr. 1	19,542,525	48,600,335	80,475,855	35,171,216	30,108,803
Bulgaria	Jan. 1	8,624,508	12,234,810	19,240,949	16,542,617	9,858,730
Canada	Jan. 1	34,025,291	17,307,819	15,163,595	41,672,589	[b] 35,616,624
Chile	Jan. 1	918,661	1,979,146	2,718,470	294,656	[c] 294,656
Germany [c]	Jan. 1	3,019,553	6,626,109	5,864,239	6,050,111	7,365,175
Netherlands	Jan. 1	36,979,823	39,740,530	40,681,553	53,052,451	33,126,858
Roumania	Jan. 1	33,750,616	30,611,933	26,107,148	63,066,299	[d] 63,066,299
Russia	Jan. 1	111,977,478	153,448,855	169,058,193	176,852,636	[b] 32,372,070
Servia	Jan. 1	1,855,771	1,841,636	3,056,539	3,422,554	3,365,644
United States	July 1	114,181,420	44,230,169	4,394,402	34,973,291	76,569,423
Other countries	....	9,054,989	4,547,909	5,294,121	5,706,976	[b] 5,919,965
Total	....	419,895,748	436,511,810	505,774,020	582,310,395	528,649,463

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	3,474,951	824,753	8,057,794	3,974,199	1,185,454
Belgium	Jan. 1	57,062,144	59,497,821	63,979,307	64,789,991	67,928,168
Brazil	Jan. 1	5,501,214	6,200,299	7,112,130	7,873,510	8,511,259
Denmark	Jan. 1	4,329,013	3,686,313	3,861,670	3,447,367	4,168,334
France	Jan. 1	9,029,614	17,365,172	7,580,618	6,713,342	11,288,433
Germany [c]	Jan. 1	76,225,923	70,882,595	74,263,743	84,054,403	73,784,363
Greece	Jan. 1	6,275,321	6,109,739	5,132,775	5,733,503	7,426,048
Italy	Jan. 1	43,274,048	43,115,829	29,617,847	43,047,890	50,473,976
Japan	Jan. 1	192,298	2,812,509	888,558	2,281,022	789,540
Netherlands	Jan. 1	47,293,883	49,668,874	50,510,097	61,992,589	44,506,710
Portugal	Jan. 1	336,955	2,748,269	3,282,298	4,672,573	[d] 4,672,573
Spain	Jan. 1	2,556,594	3,336,229	8,192,327	32,517,661	19,312,985
Sweden	Jan. 1	7,510,655	8,238,201	8,082,561	7,255,222	7,838,974
Switzerland	Jan. 1	15,226,501	16,324,627	17,220,343	16,158,553	16,196,009
United Kingdom	Jan. 1	150,893,534	164,206,362	181,984,062	181,579,837	172,808,563
Other countries	....	12,277,649	22,768,700	13,245,602	11,839,012	[b] 10,482,759
Total	....	441,460,297	477,786,292	483,011,732	537,930,674	501,374,148

International trade in wheat flour, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Argentina	Jan. 1	439,125	809,636	1,206,896	1,628,271	1,450,979
Australia	Jan. 1	336,949	62,214	1,052,500	1,573,663	1,702,806
Austria-Hungary	Jan. 1	1,114,607	1,095,357	859,446	795,853	653,622
Belgium	Jan. 1	316,272	358,132	758,648	857,017	439,659
British India	Apr. 1	410,330	463,098	589,426	513,746	467,692
Bulgaria	Jan. 1	154,697	211,311	232,315	214,587	261,974
Canada	Jan. 1	1,287,766	1,587,600	1,321,469	1,532,014	[b] 1,468,410
Chile	Jan. 1	27,827	64,796	95,099	91,617	[d] 91,617
Germany [c]	Jan. 1	227,802	295,698	616,939	991,701	663,437
Netherlands	Jan. 1	82,218	106,207	130,372	199,777	110,985
Roumania	Jan. 1	214,505	277,557	135,900	484,511	484,511
Russia	Jan. 1	643,285	1,025,773	1,172,442	1,090,480	1,057,405
Servia	Jan. 1	4,402	38,827	9,286	21,794	....
United States	July 1	19,716,484	16,999,432	8,826,335	13,919,048	15,584,667
Other countries	....	1,209,786	1,058,533	1,258,028	1,646,506	[b] 1,846,169
Total	....	26,186,055	24,454,171	18,265,101	25,560,585	26,283,933

[a] See "General note," p. 615.
[b] Preliminary.
[c] Not including free ports prior to March 1, 1906.
[d] Year preceding.

International trade in wheat flour, 1902–1906 [a]—Continued.

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
China	Jan. 1	723,000	533,136	654,307	633,851	1,214,069
Cuba	Jan. 1	595,360	564,201	645,736	764,024	735,950
Belgium	Jan. 1	99,022	66,507	40,255	41,516	55,601
Brazil	Jan. 1	1,187,695	1,317,531	1,474,049	1,579,954	1,731,596
Denmark	Jan. 1	341,469	395,713	335,896	276,489	328,972
Egypt	Jan. 1	657,394	762,364	886,729	1,365,764	1,684,257
Finland	Jan. 1	670,193	764,152	757,085	794,748	879,955
France	Jan. 1	328,927	255,777	232,150	140,854	98,572
Germany [b]	Jan. 1	354,818	359,704	260,600	240,560	242,116
Greece	Jan. 1	26,866	21,762	16,584	28,942	110,867
Italy	Jan. 1	12,476	13,085	11,700	12,513	15,043
Japan	Jan. 1	496,633	1,411,611	1,291,886	1,242,854	1,074,095
Netherlands	Jan. 1	1,879,773	1,974,151	1,868,040	1,863,924	2,260,321
Spain	Jan. 1	14,178	6,002	13,694	663,272	161,765
Sweden	Jan. 1	98,375	93,494	80,852	57,839	83,949
United Kingdom	Jan. 1	11,040,771	11,754,350	8,384,319	6,779,921	8,024,846
Other countries		4,194,862	5,915,801	3,719,305	4,727,352	[c] 4,796,222
Total		22,721,812	26,209,341	20,673,187	21,214,377	23,498,196

[a] See "General note," p. 615.
[b] Not including free ports prior to March 1, 1906.
[c] Preliminary.

International trade in wheat, including wheat flour, 1902–1906. [a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Argentina	Jan. 1	25,672,368	65,421,537	90,115,119	112,718,476	89,128,802
Australia	Jan. 1	10,799,165	1,489,763	38,850,166	32,506,453	38,878,679
Austria-Hungary	Jan. 1	5,534,270	5,532,485	3,984,789	3,630,659	4,059,153
Belgium	Jan. 1	13,890,599	13,362,799	18,217,597	18,496,029	18,030,378
British India	Apr. 1	21,389,010	50,684,276	83,128,272	37,483,073	32,213,417
Bulgaria	Jan. 1	9,320,644	13,185,710	20,286,368	17,508,259	11,037,613
Canada	Jan. 1	39,820,238	24,452,019	21,110,205	48,566,652	42,224,469
Chile	Jan. 1	1,043,883	2,270,728	3,146,416	706,932	[b] 706,932
Germany [c]	Jan. 1	4,044,662	7,956,750	8,640,465	10,512,765	10,350,641
Netherlands	Jan. 1	37,349,804	40,218,462	41,268,227	53,951,447	33,626,290
Roumania	Jan. 1	34,715,888	31,860,939	26,718,698	65,246,599	[b] 65,246,599
Russia	Jan. 1	114,872,260	158,064,833	174,334,182	181,759,796	[d] 137,130,392
Servia	Jan. 1	1,875,580	2,016,358	3,098,326	3,520,627	3,365,644
United States	July 1	202,905,598	120,727,613	44,112,910	97,609,007	146,700,424
Other countries		14,499,026	9,311,307	10,955,245	13,116,253	[d] 14,227,728
Total		537,732,995	546,555,579	587,966,975	697,333,027	646,927,161

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Belgium	Jan. 1	57,507,743	59,797,102	64,160,454	64,976,813	68,178,372
Brazil	Jan. 1	10,845,841	12,129,189	13,745,351	14,983,303	16,303,441
Denmark	Jan. 1	5,865,624	5,467,021	5,373,202	4,691,567	5,648,708
Finland	Jan. 1	3,026,987	3,442,443	3,413,761	3,580,581	3,966,877
France	Jan. 1	10,509,786	18,516,169	8,625,293	7,347,185	11,732,007
Germany [c]	Jan. 1	77,822,604	72,501,263	75,436,443	85,136,923	74,873,885
Greece	Jan. 1	6,396,218	6,207,668	5,207,403	5,863,742	7,924,950
Italy	Jan. 1	43,330,190	43,174,711	29,670,497	43,104,199	50,541,670
Japan	Jan. 1	2,427,147	9,164,759	6,702,045	7,873,865	5,622,967
Netherlands	Jan. 1	55,752,861	58,552,553	58,916,277	70,380,247	54,678,154
Portugal	Jan. 1	336,955	2,748,269	3,282,298	4,672,573	[b] 4,672,573
Spain	Jan. 1	2,620,395	3,363,238	8,253,950	35,502,385	20,040,928
Sweden	Jan. 1	7,953,342	8,658,924	8,446,395	7,515,498	8,216,745
Switzerland	Jan. 1	15,226,501	16,324,627	17,220,343	16,158,553	16,196,009
United Kingdom	Jan. 1	200,577,004	217,100,937	219,713,497	212,089,481	208,920,370
Other countries		43,509,254	58,579,453	47,873,864	49,518,455	[d] 49,598,374
Total		543,708,452	595,728,326	576,041,073	633,395,370	607,116,030

[a] See "General note," p. 615.
[b] Year preceding.
[c] Not including free ports prior to March 1, 1906.
[d] Preliminary.

OATS.

Oat crop of countries named, 1903–1907.

Country.	1903.	1904.	1905.	1906.	1907.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	784,094,000	894,596,000	953,216,000	964,905,000	754,443,000
Canada:					
New Brunswick	5,974,000	5,316,000	5,659,000	5,875,000	5,929,000
Ontario	113,337,000	105,393,000	108,890,000	111,756,000	86,157,000
Manitoba	34,077,000	37,434,000	46,917,000	52,291,000	43,469,000
Saskatchewan	9,453,000	11,095,000	19,819,000	24,721,000	24,060,000
Alberta	5,351,000	5,786,000	9,814,000	13,551,000	8,254,000
Other	43,000,000	43,000,000	43,000,000	43,000,000	43,000,000
Total Canada	211,192,000	208,024,000	234,099,000	251,194,000	210,869,000
Mexico	13,000	18,000	17,000	17,000	17,000
Total North America	995,299,000	1,102,638,000	1,187,332,000	1,216,116,000	965,329,000
EUROPE.					
Austria-Hungary:					
Austria	128,330,000	109,611,000	123,880,000	154,551,000	170,657,000
Hungary proper	87,334,000	62,775,000	78,009,000	87,733,000	79,484,000
Croatia-Slavonia	7,330,000	4,907,000	6,075,000	5,541,000	4,200,000
Bosnia-Herzegovina	5,612,000	3,829,000	2,935,000	3,543,000	2,831,000
Total Austria-Hungary	228,606,000	181,122,000	210,899,000	251,368,000	257,172,000
Belgium	48,345,000	37,499,000	33,786,000	45,228,000	45,000,000
Bulgaria	11,389,000	11,179,000	10,263,000	18,793,000	18,000,000
Denmark	41,176,000	38,183,000	32,659,000	40,179,000	40,000,000
Finland	17,046,000	16,995,000	18,060,000	18,000,000	18,000,000
France	300,366,000	257,811,000	269,581,000	256,943,000	314,132,000
Germany	542,432,000	477,852,000	451,017,000	580,875,000	630,324,000
Italy	16,000,000	14,000,000	16,000,000	18,000,000	20,000,000
Netherlands	20,112,000	18,592,000	16,045,000	19,588,000	20,000,000
Norway	9,091,000	6,922,000	9,868,000	9,297,000	6,000,000
Roumania	31,405,000	12,608,000	18,974,000	26,165,000	17,842,000
Russia:					
Russia proper	650,405,000	1,006,102,000	767,550,000	544,933,000	728,351,000
Poland	58,745,000	44,393,000	61,933,000	66,425,000	72,573,000
Northern Caucasia	18,899,000	14,573,000	22,184,000	21,933,000	19,697,000
Total Russia (European)	728,049,000	1,065,068,000	851,667,000	633,291,000	820,621,000
Servia	4,398,000	3,167,000	3,549,000	4,642,000	2,984,000
Spain	22,942,000	18,500,000	22,250,000	45,632,000	16,998,000
Sweden	59,641,000	51,578,000	58,488,000	64,550,000	67,741,000
United Kingdom:					
Great Britain—					
England	85,400,000	86,728,000	76,453,000	84,102,000	94,707,000
Scotland	36,379,000	37,034,000	36,390,000	35,108,000	36,056,000
Wales	6,832,000	7,661,000	7,264,000	8,063,000	7,875,000
Ireland	58,816,000	60,142,000	60,754,000	62,751,000	60,080,000
Total United Kingdom	187,427,000	191,565,000	180,861,000	190,024,000	198,718,000
Total Europe	2,268,425,000	2,402,641,000	2,203,967,000	2,222,575,000	2,493,532,000
ASIA.					
Cyprus	481,000	417,000	402,000	359,000	400,000
Russia:					
Central Asia	11,342,000	8,014,000	14,279,000	9,805,000	18,048,000
Siberia	60,352,000	51,101,000	70,672,000	69,873,000	67,114,000
Transcaucasia[a]	40,000	20,000	44,000	35,000	14,000
Total Russia (Asiatic)	71,734,000	59,135,000	84,995,000	79,713,000	85,176,000
Total Asia	72,215,000	59,552,000	85,397,000	80,072,000	85,576,000
AFRICA.					
Algeria	7,976,000	6,631,000	7,036,000	7,000,000	7,000,000
Cape of Good Hope	2,503,000	3,000,000	3,000,000	3,000,000	3,000,000
Natal	6,000	43,000	9,000	7,000	8,000
Tunis	1,631,000	4,635,000	2,032,000	2,411,000	2,000,000
Total Africa	12,116,000	14,309,000	12,077,000	12,418,000	12,008,000

[a] Includes Chernomorsk only.

Oat crop of countries named, 1903–1907—Continued.

Country.	1903.	1904.	1905.	1906.	1907.
AUSTRALASIA.					
Australia:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Queensland	1,000	73,000	16,000	6,000	30,000
New South Wales	363,000	1,292,000	673,000	911,000	1,449,000
Victoria	4,542,000	13,858,000	6,353,000	7,460,000	9,124,000
South Australia	640,000	931,000	573,000	897,000	924,000
Western Australia	173,000	267,000	233,000	293,000	472,000
Tasmania	1,808,000	1,673,000	1,216,000	1,238,000	2,042,000
Total Australia	7,527,000	18,094,000	9,064,000	10,805,000	14,041,000
New Zealand	22,452,000	15,583,000	15,012,000	13,108,000	11,555,000
Total Australasia	29,979,000	33,677,000	24,076,000	23,913,000	25,596,000
Grand total	3,378,034,000	3,612,817,000	3,512,849,000	3,555,094,000	3,582,041,000

Acreage, production, value, prices, exports, etc., of oats in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including oatmeal, fiscal year beginning July 1.[a]	Imports during fiscal year beginning July 1.[a]
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1850[b]			146,584,179								
1860[b]			172,643,185								
1866	8,864,19	30.2	268,141,077	35.1	94,057,945	36	43	59	78	825,895	778,198
1867	10,746,416	25.9	278,698,000	44.5	123,902,556	52	57¼			122,554	780,798
1868	9,665,736	26.4	254,960,800	41.7	106,355,976	43	49½	56¾	62½	481,871	326,659
1869	9,461,441	30.5	288,334,000	38.0	109,521,734	40	44¾	46½	53½	121,517	2,266,785
1870	8,792,395	28.1	247,277,400	39.0	96,443,637	37¾	41	47¼	51	147,572	509,514
1871	8,365,809	30.6	255,743,000	36.2	92,591,359	30¾	33	34¾	42½	262,975	535,250
1872	9,000,769	30.2	271,747,000	29.9	81,303,518	23½	25¾	30	34	714,072	225,555
1873	9,751,700	27.7	270,340,000	34.6	93,474,161	34	40⅝	44	48½	812,873	191,802
1874	10,897,412	22.1	240,369,000	47.1	113,133,934	51¾	54½	57¼	64½	504,770	1,500,040
1875	11,915,075	29.7	354,317,500	32.0	113,441,491	29½	30½	28⅝	31½	1,466,228	121,547
1876	13,358,908	24.0	320,884,000	32.4	103,844,896	31¾	34½	37¼	45¾	2,854,128	41,597
1877	12,826,148	31.7	406,394,000	28.4	115,546,194	24⅛	27	23	27	3,715,479	21,391
1878	13,176,500	31.4	413,578,560	24.5	101,752,468	19⅝	20⅜	24⅜	30½	5,452,136	13,395
1879	12,683,500	28.7	363,761,320	33.1	120,533,294	32¾	36¾	29½	34⅞	766,366	489,576
1880	16,187,977	25.8	417,885,380	36.0	150,243,565	29⅛	33½	36¼	39½	402,904	64,412
1881	16,831,600	24.7	416,481,000	46.4	193,198,970	43½	46¾	48¾	56⅝	625,690	1,850,983
1882	18,494,691	26.4	488,250,610	37.5	182,978,022	34¾	41½	38¾	42¾	461,496	815,017
1883	20,324,962	28.1	571,302,400	32.7	187,040,264	29⅝	36⅛	30¾	34¼	3,274,622	121,069
1884	21,300,917	27.4	583,628,000	27.7	161,528,470	22½	25¼	34½	37	6,203,104	94,310
1885	22,783,630	27.6	629,409,000	28.5	179,631,860	27	29	26¼	29⅝	7,311,306	149,480
1886	23,658,474	26.4	624,134,000	29.8	186,137,930	25¾	27¼	25⅛	27½	1,374,635	139,575
1887	25,920,906	25.4	659,618,000	30.4	200,699,790	28⅝	30⅞	32½	38	573,080	123,817
1888	26,998,282	26.0	701,735,000	27.8	195,424,240	25	26⅞	21⅝	23⅝	1,191,471	131,501
1889	27,462,316	27.4	751,515,000	22.9	171,781,008	20	21	24¾	30	15,107,238	153,232
1890	26,431,369	19.8	523,621,000	42.4	222,048,486	39⅞	43⅞	45¼	54	1,382,836	41,848
1891	25,581,861	28.9	738,394,000	31.5	232,312,267	31⅜	33⅝	28⅛	33½	10,586,644	47,782
1892	27,063,835	24.4	661,035,000	31.7	209,253,611	25⅝	31¼	28¾	32¼	2,700,793	49,433
1893	27,273,033	23.4	638,854,850	29.4	187,576,092	27½	29⅛	32½	36	6,290,229	31,759
1894	27,023,553	24.5	662,036,928	32.4	214,816,920	28¾	29⅜	27½	30¾	1,708,824	330,318
1895	27,878,406	29.6	824,443,537	19.9	163,655,068	16⅝	17½	18	19⅜	15,156,618	66,602
1896	27,565,985	25.7	707,346,404	18.7	132,485,033	16½	18¾	16⅞	18¾	37,725,083	131,204
1897	25,730,375	27.2	698,767,809	21.2	147,974,719	21	23⅞	26	32	73,880,307	25,093
1898	25,777,110	28.4	730,906,643	25.5	186,405,364	26	27¾	24	27¾	33,534,362	28,098
1899	26,341,380	30.2	796,177,713	24.9	198,167,975	22¼	23	21¼	23¾	45,048,857	54,576
1900	27,364,795	29.6	809,125,989	25.8	208,669,233	21¾	22¾	27⅞	31	42,268,931	32,107
1901	28,541,476	25.8	736,808,724	39.9	293,658,777	42	48¼	41	49½	13,277,612	38,978
1902	28,653,144	34.5	987,842,712	30.7	303,584,852	29¼	32	33⅜	38¼	8,381,805	150,065
1903	27,638,126	28.4	784,094,199	34.1	267,661,665	34¼	38	39⅝	44¾	1,960,740	183,983
1904	27,842,669	32.1	894,595,552	31.3	279,900,013	28¼	32	c 28⅝	c 32	8,394,692	55,699
1905	28,046,746	34.0	953,216,197	29.1	277,047,537	c 29½	c 32¾	c 32⅛	c 34¾	48,434,541	40,025
1906	30,958,768	31.2	964,904,522	31.7	306,292,978	c 33	c 35¾	c 44½	c 48½	6,386,334	91,289
1907	31,837,000	23.7	754,443,000	44.3	334,568,000	c 46½	c 50⅞	52¾	56½		

[a] In years 1866 to 1882, inclusive, oatmeal is not included.
[b] Census figures.
[c] Quotations are for standard.

Condition of the oat crop in the United States, monthly, 1890–1907.

Year.	June.	July.	August.	When harvested.	Year.	June.	July.	August.	When harvested.	Year.	June.	July.	August.	When harvested.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1890	89.8	81.6	70.1	64.4	1896	98.8	96.3	77.3	74.0	1902	90.6	92.1	89.4	87.2
1891	85.1	87.6	89.5	90.7	1897	89.0	87.5	86.0	84.6	1903	85.5	84.3	79.5	75.7
1892	88.5	87.2	86.2	78.9	1898	98.0	92.8	84.2	79.0	1904	89.2	89.8	86.6	85.6
1893	88.9	88.8	78.3	74.9	1899	88.7	90.0	90.8	87.2	1905	92.9	92.1	90.8	90.3
1894	87.0	77.7	76.5	77.8	1900	91.7	85.5	85.0	82.9	1906	85.9	84.0	82.8	81.9
1895	84.3	83.2	84.5	86.0	1901	85.3	83.7	73.6	72.1	1907	81.6	81.0	75.6	65.5

Acreage, production, value, and distribution of oats in the United States in 1907, by States.

State or Territory.	Crop of 1907.			Stock in farmers' hands March 1, 1908.		Shipped out of county where grown.
	Acreage.	Production.	Farm value Dec. 1.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	115,000	4,266,000	2,560,000	1,578,000	37	85,000
New Hampshire	13,000	423,000	258,000	114,000	27	4,000
Vermont	78,000	2,652,000	1,671,000	928,000	35	27,000
Massachusetts	7,000	245,000	147,000	91,000	37	2,000
Rhode Island	2,000	59,000	39,000	17,000	29	1,000
Connecticut	10,000	315,000	189,000	85,000	27	0
New York	1,208,000	37,086,000	21,139,000	14,834,000	40	2,225,000
New Jersey	60,000	1,770,000	991,000	779,000	44	177,000
Pennsylvania	1,003,000	29,689,000	16,032,000	12,172,000	41	2,672,000
Delaware	4,000	120,000	60,000	38,000	32	17,000
Maryland	30,000	825,000	404,000	248,000	30	91,000
Virginia	146,000	2,862,000	1,431,000	944,000	33	114,000
West Virginia	95,000	1,834,000	990,000	569,000	31	37,000
North Carolina	192,000	2,995,000	1,797,000	719,000	24	90,000
South Carolina	195,000	3,900,000	2,808,000	663,000	17	78,000
Georgia	300,000	5,010,000	3,607,000	852,000	17	150,000
Florida	30,000	411,000	308,000	49,000	12	8,000
Ohio	1,600,000	36,480,000	16,416,000	12,768,000	35	10,214,000
Indiana	1,816,000	36,683,000	15,407,000	11,005,000	30	15,407,000
Illinois	4,150,000	101,675,000	41,687,000	35,586,000	35	44,737,000
Michigan	1,468,000	30,534,000	14,656,000	10,687,000	35	6,107,000
Wisconsin	2,350,000	51,700,000	24,299,000	20,680,000	40	7,238,000
Minnesota	2,530,000	61,985,000	25,414,000	24,794,000	40	16,736,000
Iowa	4,500,000	108,900,000	41,382,000	37,026,000	34	46,827,000
Missouri	663,000	14,254,000	5,844,000	4,704,000	33	2,423,000
North Dakota	1,320,000	32,340,000	12,936,000	14,876,000	46	3,557,000
South Dakota	1,325,000	32,728,000	12,764,000	13,418,000	41	8,509,000
Nebraska	2,524,000	51,490,000	19,051,000	19,051,000	37	18,536,000
Kansas	1,092,000	16,380,000	6,879,000	4,750,000	29	1,638,000
Kentucky	192,000	3,379,000	1,656,000	1,081,000	32	101,000
Tennessee	147,000	3,058,000	1,529,000	826,000	27	550,000
Alabama	220,000	3,850,000	2,579,000	654,000	17	116,000
Mississippi	90,000	1,611,000	1,047,000	290,000	18	32,000
Louisiana	28,000	406,000	223,000	37,000	9	0
Texas	500,000	9,500,000	5,700,000	1,140,000	12	1,425,000
Oklahoma	418,000	6,270,000	3,009,000	1,881,000	30	1,129,000
Arkansas	175,000	3,412,000	1,843,000	717,000	21	68,000
Montana	240,000	11,760,000	5,410,000	4,586,000	39	4,116,000
Wyoming	60,000	2,220,000	1,177,000	622,000	28	155,000
Colorado	155,000	5,890,000	2,945,000	1,944,000	33	1,472,000
New Mexico	12,000	462,000	254,000	74,000	16	69,000
Arizona	4,000	116,000	70,000	17,000	15	26,000
Utah	45,000	2,025,000	972,000	688,000	34	608,000
Nevada	7,000	301,000	217,000	54,000	18	0
Idaho	113,000	5,706,000	2,397,000	1,883,000	33	2,739,000
Washington	190,000	10,545,000	4,745,000	3,480,000	33	4,745,000
Oregon	279,000	9,765,000	4,394,000	2,930,000	30	3,906,000
California	136,000	4,556,000	3,235,000	547,000	12	1,959,000
United States	31,837,000	754,443,000	334,568,000	267,476,000	35.5	210,923,000

Average yield per acre of oats in the United States, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	36.0	35.0	37.5	35.0	39.0	39.5	36.6	39.5	35.8	37.1
New Hampshire	33.0	35.0	32.6	29.5	35.0	31.1	33.2	32.8	34.5	32.5
Vermont	38.0	37.0	34.9	33.0	40.0	38.2	37.9	39.4	37.2	34.0
Massachusetts	32.0	33.0	36.8	31.0	32.2	31.7	34.0	32.0	34.0	35.0
Rhode Island	27.0	26.0	30.9	29.4	36.2	28.1	25.4	29.4	29.3	29.5
Connecticut	28.2	28.0	31.0	28.7	34.5	31.2	33.5	34.5	34.2	31.5
New York	27.5	31.0	27.9	21.6	40.0	34.0	34.1	34.2	32.3	30.7
New Jersey	19.6	24.0	29.6	16.0	32.2	25.4	32.5	32.0	26.6	29.5
Pennsylvania	23.3	33.0	31.1	18.9	36.5	28.6	33.9	34.0	27.4	29.6
Delaware	22.0	20.0	21.0	18.5	22.6	22.2	28.2	31.2	24.5	30.0
Maryland	19.5	23.0	24.0	18.8	26.7	20.6	29.7	27.7	25.4	27.5
Virginia	16.1	14.0	14.8	14.9	17.5	13.8	21.1	17.8	18.0	19.6
West Virginia	19.5	23.0	21.0	18.7	28.6	21.7	26.4	24.1	20.6	19.3
North Carolina	14.3	12.0	13.9	14.4	12.7	11.4	15.8	15.3	16.2	15.6
South Carolina	17.2	12.0	15.5	15.8	13.1	14.0	17.1	16.3	18.5	20.0
Georgia	16.6	9.0	15.0	14.8	11.1	13.6	14.8	15.1	15.5	16.7
Florida	15.4	9.0	11.3	13.1	13.6	13.2	12.9	12.0	14.0	13.7
Ohio	30.9	36.0	38.0	31.5	41.1	30.6	40.9	35.8	32.8	22.8
Indiana	29.2	32.0	32.7	28.6	35.4	24.4	33.1	35.3	28.2	20.2
Illinois	29.0	38.0	38.0	28.2	37.7	26.6	32.0	35.5	29.5	24.5
Michigan	32.8	34.0	36.7	29.0	39.9	30.5	32.5	35.6	30.7	20.8
Wisconsin	36.1	36.0	32.0	29.1	39.9	32.8	35.0	39.0	37.4	22.0
Minnesota	36.3	32.0	25.2	32.1	39.0	32.3	39.2	37.5	32.5	24.5
Iowa	34.0	33.0	34.0	29.8	30.7	24.0	32.0	35.0	33.8	24.2
Missouri	17.0	25.0	27.4	11.2	32.5	22.1	22.7	27.2	22.8	21.5
North Dakota	30.7	30.0	10.3	32.6	38.4	27.4	37.4	38.9	32.5	24.5
South Dakota	26.8	26.0	21.5	28.8	34.8	38.6	39.0	39.0	36.4	24.7
Nebraska	32.1	30.0	21.8	19.8	34.6	29.5	30.7	31.0	29.5	20.4
Kansas	18.0	29.0	31.6	18.6	33.5	26.2	17.8	27.1	23.6	15.0
Kentucky	22.4	18.0	21.3	19.7	22.2	20.1	24.0	25.5	21.5	17.6
Tennessee	18.7	14.0	16.6	17.5	17.3	18.5	21.1	20.2	21.5	20.8
Alabama	16.8	10.0	14.4	14.5	10.9	15.8	14.9	16.5	17.2	17.5
Mississippi	18.5	10.0	14.0	15.2	15.4	15.0	19.2	18.5	18.0	17.9
Louisiana	18.1	18.0	18.0	13.4	15.2	15.9	18.4	16.0	17.2	14.5
Texas	29.7	25.0	38.0	16.3	23.2	35.5	32.0	31.4	34.8	19.0
Indian Territory	......	......	......	25.0	32.6	30.0	32.2	36.0	34.2	15.0
Oklahoma	......	......	......	20.7	47.8	26.4	21.2	33.0	34.4	
Arkansas	22.8	19.0	22.2	12.3	20.0	18.6	22.7	20.3	20.5	19.5
Montana	40.6	38.0	39.0	42.0	41.9	46.4	37.7	41.3	43.2	49.0
Wyoming	31.2	30.0	34.2	41.0	36.0	29.4	30.2	39.9	39.5	37.0
Colorado	35.8	27.0	32.8	33.8	26.8	33.3	35.4	35.0	40.4	38.0
New Mexico	38.8	24.0	30.1	31.6	19.1	22.6	19.6	29.5	34.6	38.5
Arizona	......	......	......	35.0	31.7	35.5	30.1	31.2	34.4	29.0
Utah	39.7	34.0	35.9	33.0	35.5	36.4	37.6	39.8	43.7	45.0
Nevada	......	......	......	43.0	34.8	28.6	37.0	37.2	38.8	43.0
Idaho	43.6	34.0	36.6	38.3	42.1	41.5	39.3	39.4	40.7	50.5
Washington	41.9	37.0	34.4	47.5	46.2	47.9	44.9	50.0	43.2	55.5
Oregon	27.0	30.0	18.5	31.5	28.7	33.8	23.1	24.1	33.8	35.0
California	33.0	31.0	24.6	30.4	30.5	34.8	34.1	28.0	31.5	33.5
General average	28.4	30.2	29.6	25.8	34.5	28.4	32.1	34.0	31.2	23.7

Average farm value per acre of oats in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$12.24	$13.30	$14.25	$17.50	$17.55	$17.77	$16.47	$16.55	$15.75	$22.26
New Hampshire	12.54	13.65	12.39	15.34	15.40	14.93	15.60	14.10	15.18	19.85
Vermont	13.30	13.69	12.56	16.50	17.20	16.81	16.68	15.76	16.00	21.42
Massachusetts	11.84	12.54	13.98	17.05	14.49	15.53	15.30	13.76	14.96	21.00
Rhode Island	9.99	9.62	11.74	15.88	15.57	12.65	11.94	12.35	13.19	19.50
Connecticut	10.15	10.36	10.85	15.50	14.14	14.04	14.74	14.49	14.36	18.90
New York	8.53	10.23	8.93	10.37	14.40	13.94	12.96	12.65	12.92	17.50
New Jersey	6.08	7.92	9.18	7.52	12.56	10.92	13.00	11.84	10.11	16.52
Pennsylvania	6.99	9.57	9.33	8.50	12.41	10.58	12.88	12.24	10.41	15.98
Delaware	6.60	5.00	6.30	8.33	9.49	8.88	11.56	12.48	9.31	15.00
Maryland	5.65	6.90	7.44	7.71	10.15	8.24	10.69	9.97	9.65	13.47
Virginia	4.67	4.62	5.48	6.26	7.35	5.93	9.07	6.94	7.74	9.80
West Virginia	5.85	8.05	7.14	8.04	11.73	9.98	11.62	9.40	8.24	10.42
North Carolina	5.29	4.92	6.26	7.34	6.48	5.93	8.22	7.19	7.94	9.36
South Carolina	7.74	5.64	7.44	9.80	7.73	8.26	10.26	8.96	10.54	14.40
Georgia	7.97	4.32	7.35	9.92	5.88	7.48	8.14	8.00	8.68	12.02
Florida	8.32	4.50	5.65	9.43	8.30	7.92	7.74	6.24	9.52	10.27
Ohio	7.42	9.00	9.88	12.28	13.15	11.02	13.09	11.10	10.82	10.26
Indiana	6.72	7.36	7.52	10.87	9.91	7.81	9.93	9.53	9.02	8.48
Illinois	6.67	8.36	8.74	11.28	10.56	8.51	9.60	9.94	9.14	10.05
Michigan	8.86	9.52	9.54	11.89	13.17	10.98	10.72	10.68	10.13	9.98
Wisconsin	8.66	8.28	7.36	11.35	11.97	11.15	9.80	10.53	11.59	10.34
Minnesota	7.62	7.04	6.05	10.91	10.53	9.69	10.19	9.00	8.77	10.05
Iowa	8.16	6.27	6.80	10.73	7.67	6.96	8.00	8.40	9.13	9.20
Missouri	3.91	6.00	6.30	4.82	9.10	7.07	7.72	8.16	7.52	8.81
North Dakota	7.98	8.10	3.30	10.76	10.37	8.49	8.98	8.95	8.78	9.80
South Dakota	5.63	5.98	5.16	9.79	10.09	11.19	9.75	8.97	9.10	9.63
Nebraska	6.42	6.60	5.23	7.33	8.65	7.97	7.67	7.44	7.67	7.55
Kansas	3.96	6.38	7.27	8.00	10.05	7.86	5.87	7.59	7.32	6.30
Kentucky	6.05	5.76	6.60	8.08	7.99	8.24	9.60	8.58	8.17	8.62
Tennessee	5.24	4.48	5.81	7.87	7.27	7.77	7.80	7.88	8.82	10.40
Alabama	6.89	4.30	6.34	9.28	6.00	8.53	8.05	8.42	8.77	11.72
Mississippi	7.77	5.00	6.44	9.58	7.85	7.65	9.98	9.25	8.82	11.63
Louisiana	6.88	7.20	7.20	8.04	7.60	7.31	8.28	7.20	7.74	7.96
Texas	8.32	7.50	11.40	9.78	11.37	15.62	14.08	12.56	14.27	11.40
Indian Territory	......	......	......	11.50	12.06	10.50	12.24	11.88	10.94	7.20
Oklahoma	......	......	......	10.35	16.25	8.98	7.63	9.57	9.63	
Arkansas	6.61	6.46	7.77	7.01	8.20	8.18	9.76	8.53	8.61	10.53
Montana	14.21	14.82	16.38	15.12	15.08	16.24	17.34	17.76	19.01	22.54
Wyoming	12.48	12.00	16.07	19.68	18.00	14.70	11.78	16.36	15.80	19.62
Colorado	14.68	11.34	14.10	16.90	13.67	13.65	16.28	14.35	18.18	19.00
New Mexico	15.91	10.56	14.45	18.96	12.99	14.01	11.17	17.11	17.99	21.17
Arizona	......	......	......	21.00	23.78	21.65	22.27	19.97	22.36	17.50
Utah	15.09	13.60	15.80	16.83	16.68	17.84	17.67	17.51	19.66	21.60
Nevada	......	......	......	30.10	24.36	19.45	23.31	19.34	24.83	31.00
Idaho	15.70	12.92	14.64	16.85	20.21	18.68	19.65	16.55	17.50	21.21
Washington	16.76	14.06	13.76	16.63	22.64	18.20	19.31	20.50	17.71	24.97
Oregon	10.80	12.30	7.59	10.71	11.77	14.87	10.86	10.36	14.53	15.75
California	16.50	14.57	11.32	13.38	15.55	18.79	19.44	14.28	16.38	23.79
General average	7.23	7.52	7.63	10.29	10.60	9.68	10.05	9.88	9.89	10.51

Average farm price of oats per bushel in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents*	*Cents.*	*Cents.*	*Cents.*	*Cents*
Maine	34	38	38	50	45	45	45	43	44	60
New Hampshire	38	39	38	52	44	48	47	43	44	61
Vermont	35	37	36	50	43	44	44	40	43	63
Massachusetts	37	38	38	55	45	49	45	43	44	60
Rhode Island	37	37	38	54	43	45	47	42	45	66
Connecticut	36	37	35	54	41	45	44	42	42	60
New York	31	33	32	48	36	41	38	37	40	57
New Jersey	31	33	31	47	39	43	40	37	38	56
Pennsylvania	30	29	30	45	34	37	38	36	38	54
Delaware	30	25	30	45	42	40	41	40	38	50
Maryland	29	30	31	41	38	40	36	36	38	49
Virginia	29	33	37	42	42	43	43	39	43	50
West Virginia	30	35	34	43	41	46	44	39	40	54
North Carolina	37	41	45	51	51	52	52	47	49	60
South Carolina	45	47	48	62	59	59	60	55	57	72
Georgia	48	48	49	67	53	55	55	53	56	72
Florida	54	50	50	72	61	60	60	52	68	75
Ohio	24	25	26	39	32	36	32	31	33	45
Indiana	23	23	23	38	28	32	30	27	32	42
Illinois	23	22	23	40	28	32	30	28	31	41
Michigan	27	28	26	41	33	36	33	30	33	48
Wisconsin	24	23	23	39	30	34	28	27	31	47
Minnesota	21	22	24	34	27	30	26	24	27	41
Iowa	24	19	20	36	25	29	25	24	27	38
Missouri	23	24	23	43	28	32	34	30	33	41
North Dakota	26	27	32	33	27	31	24	23	27	40
South Dakota	21	23	24	34	29	29	25	23	25	39
Nebraska	20	22	24	37	25	27	25	24	26	37
Kansas	22	22	23	43	30	30	33	28	31	42
Kentucky	27	32	31	41	36	41	40	35	38	49
Tennessee	28	32	35	45	42	42	37	39	41	50
Alabama	41	43	44	64	55	54	54	51	51	67
Mississippi	42	50	46	63	51	51	52	50	49	65
Louisiana	38	40	40	60	50	46	45	45	45	55
Texas	28	30	30	60	49	44	44	40	41	60
Indian Territory	......	......	......	46	37	35	38	33	32	} 48
Oklahoma	......	......	......	50	34	34	36	29	28	
Arkansas	29	34	35	57	41	44	43	42	42	54
Montana	35	39	42	36	36	35	46	43	44	46
Wyoming	40	40	47	48	50	50	39	41	40	53
Colorado	41	42	43	50	51	41	46	41	45	50
New Mexico	41	44	48	60	68	62	57	58	52	55
Arizona	......	......	......	60	75	61	74	64	65	60
Utah	38	40	44	51	47	49	47	44	45	48
Nevada	......	......	......	70	70	68	63	52	64	72
Idaho	36	38	40	44	48	45	50	42	43	42
Washington	40	38	40	35	49	38	43	41	41	45
Oregon	40	41	41	34	41	44	47	43	43	45
California	50	47	46	44	51	54	57	51	52	71
General average	25.5	24.9	25.8	39.9	30.7	34.1	31.3	29.1	31.7	44.3

Average yield of oats in countries named, bushels per acre, 1897–1906.

Year.	United States.[a]	Russia, European.[b]	Germany.[b]	Austria.[b]	Hungary proper.[b]	France.[a]	United Kingdom.[a]
1897	27.2	15.1	39.9	21.5	24.3	23.1	42.1
1898	28.4	16.2	47.1	27.4	30.2	29.0	46.1
1899	30.2	23.1	48.0	30.2	33.3	27.8	44.2
1900	29.6	20.0	48.0	25.2	28.1	25.7	43.5
1901	25.8	14.4	44.6	25.6	28.1	23.5	42.9
1902	34.5	21.8	50.1	27.7	34.0	29.2	48.3
1903	28.4	17.7	51.2	28.3	34.5	31.6	44.2
1904	32.1	25.7	46.2	24.3	25.6	27.2	44.2
1905	34.0	20.2	43.6	27.7	31.1	28.6	43.9
1906	31.2	15.1	55.7	34.1	34.3	27.0	46.1
Average	30.1	18.9	47.4	27.2	30.4	27.3	44.6

[a] Winchester bushels. [b] Bushels of 32 pounds.

Wholesale prices of oats per bushel, 1903–1907.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low	High.	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*		
Jan.....	38½	44	39½	42½	35	39	31¾	34½	33½	36¾	32½	34½	36	38	$1.22½	$1.35
Feb.....	42½	43¾	39½	41	37½	39½	33½	36	36	36¾	34	35½	38	40	1.22½	1.37½
Mar.....	42	44½	40	41½	37	39	31¼	34⅜	36	36	31	34½	38	39	1.22½	1.32½
Apr.....	38	42	38	41½	33½	37	32⅛	35¾	36	36¾	32½	33½	36½	38½	1.20	1.32½
May.....	38	39½	37½	39	33	37½	33⅜	38¼	36	38	32½	35½	37	39	1.20	1.30
June....	39¾	43¾	38½	44	36	43½	35½	43¼	36½	40½	35	40	39	45	1.17½	1.27½
July....	40	43	36½	44	31½	41½	33½	45	36½	41	32½	37½	36	41½	1.17½	1.30
Aug.....	38	40½	34½	39	33	35¼	33⅝	36¾	37	38½	34	35½	35½	36¾	1.17½	1.32½
Sept....	33	42	39	41½	35	39	35½	38	37	40	35¾	38⅜	37½	40	1.17½	1.32½
Oct.....	40½	42	40	41	36½	39	34½	38½	37½	39	35	37½	38½	39¾	1.20	1.32½
Nov.....	40	42	38½	40½	35½	37½	33¼	38½	36½	38½	32⅝	35¼	36½	38½	1.25	1.32½
Dec.....	40½	42½	39	40½	37	39	34¼	38	37½	38	34¼	35⅞	37½	39	1.25	1.32½
1904.																
Jan.....	42½	45½	41	43½	38	42½	36½	41½	35	41	35½	39½	39	42½	1.25	1.37½
Feb.....	46	55½	43	48	41½	44½	39⅜	46	40	44½	38⅞	42⅞	42¼	48¼	1.25	1.37½
Mar.....	46	55½	45½	47½	41	44½	38	42¾	39	44	38¼	40⅜	44	46½	1.27½	1.37½
Apr.....	43½	47	43	46½	40	43	36⅛	41⅞	37	43¾	37¼	41	42½	45¼	1.27½	1.40
May.....	45½	47	43½	45½	41½	42½	39⅝	44¾	41	45	40	43	45	45¾	1.32½	1.50
June....	44¾	46	43½	45¼	41	44	39¾	42¼	38	44	40	42½	42½	46½	1.40	1.50
July....	41	45	43½	45½	40	41½	38½	45	37	41	36	38	41½	44	1.30	1.50
Aug.....	35½	43	34½	45	32½	40½	31½	40	31¾	42	32¼	38	33	43½	1.30	1.50
Sept....	34½	36	33	35	33	34½	29⅝	33½	29½	33½	30	32⅜	32	33½	1.40	1.52½
Oct.....	34½	36	33	34	31½	33½	28¼	31½	28½	33	27¾	30⅝	31¾	34	1.40	1.55
Nov.....	35	35	33	35¾	31	33½	29	32¼	29½	32	29	29⅝	32	32½	1.45	1.60
Dec.....	34½	36½	35½	36	32¾	33¾	28¼	32	29	32	28¼	29⅝	32½	33½	1.45	1.60
1905.							Standard				(a)					
Jan.....	35½	37½	34¼	37	32¾	33½	29⅜	31	31½	32½	28¾	29¾	33½	34½	1.45	1.60
Feb.....	36	37	35	36½	32¾	33½	29½	32¼	32	33	28⅝	30¼	33¼	34¼	1.45	1.60
Mar.....	35¾	37½	35	36¾	31¾	34½	29¼	33¼	32	34½	28½	31¼	33½	34¼	1.45	1.60
Apr.....	34¼	36	33½	35½	30½	32½	28⅜	32	32	33½	28½	29¾	33	34¼	1.45	1.60
May.....	34½	35½	33½	34½	30½	32¾	28⅝	32	31¾	34	28⅝	31⅜	33	34¾	1.45	1.67½
June....	34½	36	33¾	36½	32½	33½	30¼	33¼	33	34¼	30⅜	32½	33¾	34½	1.65	1.80
July....	33½	36½	33	36½	28	34	27	34¼	33	35½	27½	32¾	35	37	......	......
Aug.....	29	33	27½	32½	25	32	25¼	29½	27⅛	34	25½	28⅝	27	35½	......	......
Sept....	29	33½	28	32½	26	30	25	30	28	30	25¼	28⅛	26¼	30½	1.37½	1.47½
Oct.....	32½	35¾	32	35	29	32	27½	30¾	29	32	26⅞	29⅞	29¾	32¾	1.37½	1.45
Nov.....	34½	36	34	34¾	31½	33½	29	31⅜	31	32	28⅜	30	32¾	33	1.37½	1.50
Dec.....	36	37	34	36½	33	35½	29½	32¾	31½	33½	29	30⅛	32¾	35	1.45	1.55
1906.									No 3.white							
Jan.....	36	37½	34½	37	32½	34	29⅓	32	30	32	29	30	33	35	......	......
Feb.....	34	36	34	35½	32	33½	29⅜	30¾	29	31½	28½	29½	32½	33¾	......	......
Mar.....	34½	36½	34¼	35¾	32	33½	28⅞	29¾	29	32¼	28⅛	29¾	32	34	......	......
Apr.....	36¼	37	35½	38	33	35	30⅞	32¾	30½	33¾	29⅞	31½	33¼	35	......	......
May.....	37	39	37½	39	33	37	32⅛	34¾	32	35½	31⅛	34½	35¼	37¾	......	......
June....	39	45	38½	45½	37	43	33¾	42¾	33¾	43	33¾	41	37¼	43¼	......	......
July....	40	43½	38½	42½	34	41	30¼	39¼	33	40	31¾	38	38	42	......	......
Aug.....	34½	39	33½	39½	30	34	29⅛	32	29	35½	30	31	32	39	......	......
Sept....	34½	37½	34	37	31½	36	30	34¼	29	34	29¼	33	33	36½	......	......
Oct.....	37½	38½	37	37¾	35	36½	32¼	34¾	32	34½	31¼	33	36	36½	......	......
Nov.....	37½	39½	37	38½	35	36½	33	35¼	32	34¾	32	32⅝	36½	38½	......	......
Dec.....	38	39	38	39½	36	38	33	35¾	32½	35½	31⅞	34	35	37	......	......
1907.											No. 3		No 3, white			
Jan.....	38½	42	......	......	37	40	33½	37¼	32¾	38	33½	37	37	41½	1.42½	1.65
Feb.....	41½	47½	......	......	39½	45	37	41¼	37¼	42	37	39	42½	44¾	1.45	1.67½
Mar.....	46½	48½	......	......	44	45½	39⅝	43	39¾	43	38	41	41	45½	1.45	1.70
Apr.....	45½	47½	......	......	43	44½	41½	45½	40	43	39	42	42½	47½	1.50	1.75
May.....	46½	50	......	......	43½	47	44½	48½	42	48	41	44	46	49½	1.55	1.75
June....	48½	50½	......	......	46	50	41⅜	49⅜	41½	48	40½	44½	46½	50	1.40	1.70
July....	48½	49½	......	......	45½	47½	41⅛	46	41¼	46½	40	42	47¼	50	1.30	1.60
Aug.....	50½	63	......	......	45	53	44⅞	54	45	54½	41	48	49	56	1.42½	1.55
Sept....	51	53	......	......	49	52	51	56½	47	56	48	51	52	56	1.45	1.60
Oct.....	50½	55½	......	......	44½	55½	45	54¾	39	54½	46	53	50	58	1.50	1.80
Nov.....	51	52½	......	......	45	49	44½	49	45	50¼	45	48	52	53	1.60	1.85
Dec.....	51½	54½	......	......	48	53	46½	50⅞	46½	53	46	49	52	54¼	1.55	1.70

a No grade of oats in Duluth for 1905.

BARLEY.

Barley crop of countries named, 1903–1907.

Country.	1903.	1904.	1905.	1906.	1907.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	131,861,000	139,749,000	136,651,000	178,916,000	153,597,000
Canada:					
New Brunswick	108,000	96,000	100,000	102,000	100,000
Ontario	25,147,000	25,342,000	25,030,000	26,049,000	22,403,000
Manitoba	8,982,000	11,530,000	14,507,000	18,085,000	17,281,000
Saskatchewan	687,000	617,000	922,000	1,358,000	1,393,000
Alberta	1,111,000	1,659,000	1,830,000	2,226,000	1,058,000
Other	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Total Canada	39,035,000	42,244,000	45,389,000	50,820,000	45,235,000
Mexico	9,061,000	7,355,000	7,000,000	7,000,000	7,000,000
Total North America	179,957,000	189,348,000	189,040,000	236,736,000	205,832,000
EUROPE.					
Austria-Hungary:					
Austria	73,873,000	66,815,000	70,469,000	76,024,000	78,548,000
Hungary proper	64,577,000	49,915,000	62,453,000	69,747,000	63,078,000
Croatia-Slavonia	3,839,000	2,285,000	2,864,000	2,758,000	2,100,000
Bosnia-Herzegovina	4,145,000	3,496,000	3,236,000	3,276,000	2,768,000
Total Austria-Hungary	146,434,000	122,511,000	139,022,000	151,805,000	146,494,000
Belgium	3,923,000	5,003,000	4,518,000	4,349,000	4,000,000
Bulgaria	12,773,000	12,911,000	12,080,000	12,882,000	10,000,000
Denmark	23,340,000	22,708,000	21,146,000	22,049,000	22,000,000
Finland	5,233,000	4,916,000	5,318,000	5,000,000	5,000,000
France	43,345,000	38,338,000	40,841,000	36,538,000	45,095,000
Germany	152,653,000	135,409,000	134,204,000	142,901,000	160,650,000
Italy	8,000,000	7,000,000	8,000,000	8,000,000	8,000,000
Netherlands	3,823,000	3,606,000	4,013,000	3,260,000	4,000,000
Norway	3,255,000	2,496,000	3,464,000	3,262,000	2,500,000
Roumania	29,716,000	11,567,000	26,383,000	33,539,000	20,062,000
Russia:					
Russia proper	289,699,000	290,766,000	272,694,000	243,619,000	277,501,000
Poland	20,819,000	17,705,000	22,732,000	23,351,000	25,397,000
Northern Caucasia	39,968,000	31,246,000	43,410,000	37,306,000	41,206,000
Total Russia (European)	350,486,000	339,717,000	338,836,000	304,276,000	344,104,000
Servia	3,424,000	3,162,000	3,670,000	4,848,000	3,137,000
Spain	64,359,000	53,800,000	45,917,000	91,185,000	53,598,000
Sweden	13,570,000	13,452,000	12,858,000	14,328,000	13,553,000
United Kingdom:					
Great Britain—					
England	50,628,000	48,511,000	48,778,000	51,543,000	51,912,000
Scotland	7,739,000	7,408,000	8,257,000	7,803,000	7,466,000
Wales	2,981,000	3,077,000	2,906,000	3,116,000	2,885,000
Ireland	6,076,000	5,478,000	7,181,000	7,211,000	6,995,000
Total United Kingdom	67,424,000	64,474,000	67,122,000	69,673,000	69,258,000
Total Europe	931,758,000	841,070,000	867,392,000	907,895,000	911,451,000
ASIA.					
Cyprus	3,969,000	3,122,000	2,980,000	2,778,000	3,000,000
Japanese Empire:					
Japan	59,737,000	80,794,000	77,436,000	83,968,000	90,544,000
Formosa	38,000	58,000	50,000	49,000	50,000
Total Japanese Empire	59,775,000	80,852,000	77,486,000	84,017,000	90,594,000
Russia:					
Central Asia	2,759,000	2,262,000	3,145,000	2,614,000	4,385,000
Siberia	4,213,000	4,268,000	4,965,000	5,136,000	4,956,000
Transcaucasia [a]	12,000	8,000	20,000	13,000	4,000
Total Russia (Asiatic)	6,984,000	6,538,000	8,130,000	7,763,000	9,345,000
Total Asia	70,728,000	90,512,000	88,596,000	94,558,000	102,939,000

[a] Includes Chernomorsk only.

Barley crop of countries named, 1903–1907—Cont'nued.

Country.	1903.	1904.	1905.	1906.	1907.
AFRICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Algeria	38,496,000	36,125,000	27,350,000	35,000,000	35,000,000
Cape of Good Hope	949,000	900,000	900,000	900,000	900,000
Natal	4,000	6,000	7,000	5,000	5,000
Sudan (Anglo-Egyptian)	216,000	251,000	327,000	334,000	300,000
Tunis	11,322,000	14,815,000	7,119,000	7,863,000	8,000,000
Total Africa	50,987,000	52,097,000	35,703,000	44,102,000	44,205,000
AUSTRALASIA.					
Australia:					
Queensland	4,000	527,000	342,000	64,000	163,000
New South Wales	19,000	180,000	275,000	115,000	158,000
Victoria	579,000	1,256,000	902,000	1,096,000	1,295,000
South Australia	327,000	503,000	358,000	522,000	507,000
Western Australia	48,000	55,000	39,000	51,000	50,000
Tasmania	207,000	219,000	168,000	97,000	146,000
Total Australia	1,184,000	2,740,000	2,084,000	1,945,000	2,319,000
New Zealand	1,172,000	1,197,000	1,164,000	1,056,000	1,068,000
Total Australasia	2,356,000	3,937,000	3,248,000	3,001,000	3,387,000
Grand total	1,235,786,000	1,176,964,000	1,183,979,000	1,286,292,000	1,267,814,000

Condition of the barley crop in the United States, monthly, 1892–1907.

Year.	June.	July.	August.	When harvested.	Year.	June.	July.	August.	When harvested.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1892	92.1	92.0	91.1	87.4	1900	86.2	76.3	71.6	70.7
1893	88.3	88.8	84.6	83.8	1901	98.8	91.3	86.9	85.8
1894	82.2	76.8	69.8	71.5	1902	93.6	93.7	90.2	89.7
1895	90.3	91.9	87.2	87.6	1903	91.5	86.8	83.4	82.1
1896	98.0	88.1	82.9	83.1	1904	90.5	88.5	88.1	87.4
1897	87.4	88.5	87.5	86.4	1905	93.7	91.5	89.5	87.8
1898	78.8	85.7	79.3	79.2	1906	93.5	92.5	90.3	89.4
1899	91.4	92.0	93.6	86.7	1907	84.9	84.4	84.5	78.5

Average, production, value, prices, exports, etc., of barley in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Chicago cash price per bushel, No. 2.[a] December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal year beginning July 1.	Imports, fiscal year beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1850[a]	....	......	5,167,015	......	....	......	......	......	......	....	....
1860[a]	....	......	15,825,898	......	....	......	......	......	......	....	....
1866	492,532	22.9	11,283,807	70.2	7,916,342	59	70	85	100	....	3,247,250
1867	1,131,217	22.7	25,727,000	70.1	18,027,746	150	180	227	250	9,810	3,783,966
1868	937,498	24.4	22,896,100	109.0	24,948,127	140	170	149	175	59,077	5,069,880
1869	1,025,795	27.9	28,652,200	70.8	20,298,164	74	85	50	62	255,490	6,727,597
1870	1,108,924	23.7	26,295,400	79.1	20,792,213	68	80	72	95	340,093	4,866,700
1871	1,113,735	24.0	26,718,500	75.8	20,264,015	55½	64	55	71	86,891	5,565,591
1872	1,397,082	19.2	26,846,400	68.6	18,415,839	60	70	71	85	482,410	4,244,751
1873	1,387,106	23.1	32,044,491	86.7	27,794,229	132	158	130	155	320,399	4,891,189
1874	1,580,626	20.6	32,552,500	86.0	27,997,824	120	129½	115	137	91,118	6,255,063
1875	1,789,902	20.6	36,908,600	74.1	27,367,522	81	88	62½	72½	317,781	10,285,957
1876	1,766,511	21.9	38,710,500	63.0	24,402,691	63¾	68½	80	85	1,186,129	6,702,965
1877	1,614,654	21.3	34,441,400	62.8	21,629,130	56¼	64	46½	52½	3,921,501	6,764,228
1878	1,790,400	23.6	42,245,630	57.9	24,454,301	91	100	64	73	715,536	5,720,979
1879	1,680,700	24.0	40,283,100	58.9	23,714,444	86	92	75	80	1,128,923	7,135,258
1880	1,843,329	24.5	45,165,346	66.6	30,090,742	100	120	95	105	885,246	9,528,616
1881	1,967,510	20.9	41,161,330	82.3	33,862,513	101	107	100	100	205,930	12,182,722
1882	2,272,103	21.5	48,953,926	62.9	30,768,015	79	82	80	80	433,005	10,050,687
1883	2,379,009	21.1	50,136,097	58.7	29,420,423	62	67	65	74	724,955	8,596,122
1884	2,608,818	23.5	61,203,000	48.7	29,779,170	53	58	65	65	629,130	9,986,507
1885	2,729,359	21.4	58,360,000	56.3	32,867,696	62	65	58	60	252,183	10,197,115
1886	2,652,957	22.4	59,428,000	53.6	31,840,510	51	54	57	57	1,305,300	10,355,594
1887	2,901,953	19.6	56,812,000	51.9	29,464,390	80	80	69	77	550,884	10,831,461
1888	2,996,382	21.3	63,884,000	59.0	37,672,032	......	......	......	......	1,440,321	11,368,414
1889	3,220,834	24.3	78,332,976	41.6	32,614,271	58	58	......	......	1,408,311	11,332,545
1890	3,135,302	21.4	67,168,344	62.7	42,140,502	......	......	......	......	973,062	5,078,733
1891	3,352,579	25.9	86,839,153	52.4	45,470,342	......	......	......	......	2,800,075	3,146,328
1892	3,400,361	23.6	80,096,762	47.5	38,026,062	65	67	65	65	3,035,267	1,970,129
1893	3,220,371	21.7	69,869,495	41.1	28,729,386	52	54	55	60	5,219,405	791,061
1894	3,170,602	19.4	61,400,465	44.2	27,134,127	53½	55½	51	52	1,563,754	2,116,816
1895[b]	3,299,973	26.4	87,072,744	33.7	29,312,413	33	40	25	36	7,680,331	837,384
1896	2,950,539	23.6	69,695,223	32.3	22,491,241	22	37	24½	35	20,030,301	1,271,787
1897	2,719,116	24.5	66,685,127	37.7	25,142,139	25½	42	36	53	11,237,077	124,804
1898	2,583,125	21.6	55,792,257	41.3	23,064,359	40	50½	36	42	2,267,403	110,475
1899	2,878,229	25.5	73,381,563	40.3	29,594,254	35	45	36	44	23,661,662	189,757
1900	2,894,282	20.4	58,925,833	40.8	24,075,271	37	61	37	57	6,293,207	171,004
1901	4,295,744	25.6	109,932,924	45.2	49,705,163	56	63	64	72	8,714,268	57,406
1902	4,661,063	29.0	134,954,023	45.9	61,898,634	36	70	48	56	8,429,141	56,462
1903	4,993,137	26.4	131,861,391	45.6	60,166,313	42	61½	38	59	10,881,627	90,708
1904	5,145,878	27.2	139,748,958	42.0	58,651,807	38	52	40	50	10,661,655	81,020
1905	5,095,528	26.8	136,651,020	40.3	55,047,166	37	53	42	55½	17,729,360	18,049
1906	6,323,757	28.3	178,916,484	41.5	74,235,997	44	56	66	85	8,238,842	38,319
1907	6,448,000	23.8	153,597,000	66.6	102,290,000	78	102	......	......	....	....

[a] Census figures.

[b] Prices from 1895 on are for No. 3 grade.

Acreage, production, and value of barley in the United States in 1907, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	8,000	28.0	224,000	78	175,000
New Hampshire	2,000	24.0	48,000	80	38,000
Vermont	14,000	28.5	399,000	75	299,000
New York	79,000	25.0	1,975,000	80	1,580,000
Pennsylvania	9,000	25.5	230,000	70	161,000
Maryland	1,000	33.0	33,000	60	20,000
Virginia	2,000	29.0	58,000	62	36,000
Ohio	28,000	28.0	784,000	70	549,000
Indiana	9,000	20.5	184,000	67	124,000
Illinois	25,000	28.0	600,000	67	402,000
Michigan	68,000	22.0	1,496,000	67	1,002,000
Wisconsin	801,000	23.0	18,423,000	75	13,817,000
Minnesota	1,185,000	22.5	26,663,000	67	17,864,000
Iowa	556,000	25.5	14,178,000	60	8,507,000
Missouri	2,000	23.0	46,000	57	26,000
North Dakota	855,000	18.3	15,646,000	58	9,075,000
South Dakota	875,000	23.0	20,125,000	61	12,276,000
Nebraska	116,000	20.8	2,413,000	50	1,206,000
Kansas	366,000	12.0	4,392,000	54	2,372,000
Kentucky	1,000	25.0	25,000	75	19,000
Tennessee	1,000	20.0	20,000	70	14,000
Texas	4,000	17.0	68,000	73	50,000
Oklahoma	35,000	18.7	654,000	50	327,000
Montana	17,000	38.0	646,000	62	400,000
Wyoming	4,000	32.0	128,000	68	87,000
Colorado	25,000	40.0	1,000,000	60	600,000
New Mexico	1,000	26.0	26,000	70	18,000
Arizona	26,000	35.5	923,000	78	720,000
Utah	11,000	39.0	429,000	58	249,000
Nevada	7,000	40.0	280,000	83	232,000
Idaho	49,000	44.5	2,181,000	58	1,265,000
Washington	165,000	40.5	6,682,000	58	3,876,000
Oregon	61,000	42.0	2,562,000	57	1,460,000
California	1,040,000	28.9	30,056,000	78	23,444,000
United States	6,448,000	23.8	153,597,000	66.6	102,290,000

Average yield per acre of barley in the United States, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	27.0	29.0	27.4	27.5	29.4	29.9	32.7	29.0	31.5	28.0
New Hampshire	23.5	25.0	22.7	21.5	21.2	19.8	20.7	20.8	21.4	24.0
Vermont	30.0	31.0	29.1	29.6	29.7	29.2	33.1	31.5	32.8	28.5
Massachusetts	24.5	30.0	25.8	......	......	......	......	......	......	......
Rhode Island	28.0	29.0	28.0	......	......	......	......	......	......	......
New York	25.2	24.0	22.0	14.0	28.5	26.6	26.8	25.7	26.3	25.0
Pennsylvania	19.4	21.0	19.0	17.2	21.0	21.3	22.6	25.0	25.0	25.5
Maryland	......	......	......	18.0	27.0	25.9	21.8	31.0	31.0	33.0
Virginia	......	......	......	24.9	18.3	24.4	24.7	28.0	28.6	29.0
Ohio	28.7	28.0	27.0	24.9	32.3	23.3	27.5	26.2	30.0	28.0
Indiana	23.4	25.0	24.6	25.4	28.0	22.8	29.2	28.0	29.4	20.5
Illinois	27.3	29.0	25.6	24.5	28.6	28.2	27.1	30.0	30.0	28.0
Michigan	25.2	24.0	23.9	22.8	28.6	25.2	24.1	27.0	26.1	22.0
Wisconsin	29.1	30.0	25.5	27.2	33.8	27.7	30.0	29.9	30.7	23.0
Minnesota	28.4	25.0	22.4	25.8	28.6	25.3	28.4	27.0	28.0	22.5
Iowa	26.0	26.0	26.4	23.6	26.3	23.4	27.8	26.0	28.3	25.5
Missouri	20.0	18.0	20.8	16.5	25.0	18.3	20.3	23.0	24.2	23.0
North Dakota	26.4	24.0	8.2	28.2	31.6	21.6	28.1	28.0	25.8	18.3
South Dakota	23.0	23.0	14.3	22.4	29.2	31.4	28.0	30.0	29.0	23.0
Nebraska	27.1	26.0	17.6	16.0	31.1	26.6	27.4	27.5	28.0	20.8
Kansas	28.0	17.0	21.5	15.9	16.0	31.9	21.6	22.0	23.5	12.0
Kentucky	16.0	21.0	28.6	19.4	25.9	21.4	20.6	24.0	26.0	25.0
Tennessee	18.0	11.0	14.7	16.8	16.0	20.6	22.0	21.6	23.0	20.0
Texas	20.0	18.0	24.6	13.5	21.3	24.4	31.0	24.0	24.5	17.0
Oklahoma	......	......	......	22.0	36.0	26.9	30.1	26.0	29.8	18.7
Montana	36.0	35.0	38.8	39.0	37.0	40.2	29.9	33.0	33.0	38.0
Wyoming	......	......	......	32.5	24.4	21.3	30.1	31.7	31.4	32.0
Colorado	30.5	28.0	24.8	28.7	26.3	38.3	37.1	33.0	41.0	40.0
New Mexico	33.8	32.0	29.0	31.7	16.1	23.1	23.6	21.0	27.0	26.0
Arizona	......	......	......	28.7	25.2	32.8	33.6	44.0	42.2	35.5
Utah	37.0	33.0	36.5	35.0	32.1	37.5	38.3	37.0	44.0	39.0
Nevada	......	......	......	33.0	34.3	34.6	35.9	34.0	36.8	40.0

Average yield per acre of barley in the United States, 1898–1907, by States—Continued.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Idaho	35.0	35.0	32.8	40.2	46.3	34.4	37.4	40.0	41.0	44.5
Washington	39.8	35.0	33.4	43.5	43.7	37.9	34.8	40.0	36.5	40.5
Oregon	29.1	28.0	28.9	30.6	31.9	33.2	28.7	31.0	35.0	42.0
California	10.5	26.0	16.7	26.0	26.0	25.7	22.7	21.5	27.2	28.9
General average	21.6	25.5	20.4	25.6	29.0	26.4	27.2	26.8	28.3	23.8

Average farm value per acre of barley in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$15.12	$17.11	$16.99	$18.43	$19.99	$21.23	$23.22	$19.72	$20.48	$21.88
New Hampshire	13.63	16.25	15.21	17.20	15.90	16.63	15.53	15.18	13.70	19.00
Vermont	14.10	16.12	15.13	19.54	18.12	17.52	21.85	21.18	20.34	21.36
Massachusetts	16.17	20.40	17.80	......	......	......	......	......	......	......
Rhode Island	17.08	20.30	21.56	......	......	......	......	......	......	......
New York	12.10	12.00	11.22	7.84	15.68	14.63	15.28	13.88	14.47	20.00
Pennsylvania	8.54	10.29	9.50	10.15	11.34	11.93	12.66	13.75	13.75	17.89
Maryland	......	......	......	9.36	13.23	12.95	13.95	14.88	14.57	20.00
Virginia	......	......	......	11.70	9.88	13.91	15.07	15.40	16.02	18.00
Ohio	12.63	12.60	11.61	12.70	15.83	11.65	14.30	11.79	13.80	19.61
Indiana	10.30	11.25	11.56	12.95	12.88	11.40	14.02	12.60	15.29	13.78
Illinois	10.65	13.63	12.03	12.99	12.58	12.41	11.65	12.60	12.60	16.08
Michigan	11.09	11.52	11.23	12.31	14.87	13.10	13.25	12.69	12.79	14.74
Wisconsin	11.64	12.00	11.22	13.87	15.55	13.30	12.90	12.26	13.82	17.25
Minnesota	9.37	7.75	8.51	11.61	10.58	9.36	9.09	8.64	9.80	15.08
Iowa	8.84	8.06	9.77	11.09	9.47	8.42	10.01	7.80	9.90	15.30
Missouri	7.20	7.56	9.36	9.08	13.75	9.88	12.59	10.12	11.62	13.00
North Dakota	7.66	7.92	2.87	11.28	11.38	7.78	7.87	8.40	8.51	10.61
South Dakota	6.21	6.67	4.43	9.41	11.10	10.36	8.96	8.70	9.28	14.03
Nebraska	6.78	7.80	5.81	6.56	10.26	8.78	8.49	8.52	8.68	10.40
Kansas	7.56	4.59	7.10	7.15	6.08	10.85	7.99	7.04	7.76	6.48
Kentucky	6.40	9.03	15.73	13.77	14.50	13.48	13.39	10.56	14.30	19.00
Tennessee	10.08	7.04	9.11	11.76	9.76	13.39	14.08	12.31	13.80	14.00
Texas	10.00	11.88	17.71	11.88	15.34	17.08	22.63	15.84	14.95	12.50
Oklahoma	......	......	......	10.78	15.12	11.84	12.04	10.40	9.83	9.34
Montana	20.52	17.85	18.62	22.28	18.87	23.32	18.54	18.48	18.48	23.53
Wyoming	......	......	......	21.12	18.30	15.34	17.16	18.70	20.10	21.75
Colorado	14.03	15.40	12.40	18.08	15.78	23.36	21.15	17.49	22.14	24.00
New Mexico	18.59	19.52	17.98	20.61	11.43	14.78	21.24	14.49	17.01	18.00
Arizona	......	......	......	19.52	22.93	23.62	31.25	35.64	32.07	27.69
Utah	17.39	17.16	20.07	18.55	18.94	22.13	21.83	19.61	23.76	22.64
Nevada	......	......	......	23.10	27.44	29.41	25.85	23.80	25.39	33.14
Idaho	16.80	16.10	16.40	21.31	24.54	17.89	23.56	19.20	20.50	25.82
Washington	17.91	15.40	13.03	17.83	20.10	18.95	17.05	18.80	17.89	23.49
Oregon	14.26	14.00	12.14	14.99	16.59	19.59	16.93	16.12	18.20	23.93
California	6.82	13.00	7.18	10.66	16.38	15.68	13.62	12.68	14.69	22.54
General average	8.93	10.28	8.32	11.57	13.28	12.05	11.40	10.80	11.74	15.86

Average farm price of barley per bushel in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	56	59	62	67	68	71	71	68	65	78
New Hampshire	58	65	67	80	75	84	75	73	64	80
Vermont	47	52	52	66	61	60	66	54	62	75
Massachusetts	66	68	69							
Rhode Island	61	70	77							
New York	48	50	51	56	55	55	57	54	55	80
Pennsylvania	44	49	50	59	54	56	56	55	55	70
Maryland				52	49	50	64	48	47	60
Virginia				47	54	57	61	55	56	62
Ohio	44	45	43	51	49	50	52	45	46	70
Indiana	44	45	47	51	46	50	48	45	52	67
Illinois	39	47	47	53	44	44	43	42	42	67
Michigan	44	48	47	54	52	52	55	47	49	67
Wisconsin	40	40	44	51	46	48	43	41	45	75
Minnesota	33	31	38	45	37	37	32	32	35	67
Iowa	34	31	37	47	36	36	36	30	35	60
Missouri	36	42	45	55	55	54	62	44	48	57
North Dakota	29	33	35	40	36	36	28	30	33	58
South Dakota	27	29	31	42	38	33	32	29	32	61
Nebraska	25	30	33	41	33	33	31	31	31	50
Kansas	27	27	33	45	38	34	37	32	33	54
Kentucky	40	43	55	71	56	63	65	44	55	75
Tennessee	56	64	62	70	61	65	64	57	60	70
Texas	50	66	72	88	72	70	73	66	61	73
Oklahoma				49	42	44	40	40	33	50
Montana	57	51	48	52	51	58	62	56	56	62
Wyoming				65	75	72	57	59	64	68
Colorado	46	55	50	63	60	61	57	53	54	60
New Mexico	55	61	62	65	71	64	90	69	63	70
Arizona				68	91	72	93	81	76	78
Utah	47	52	55	53	59	59	57	53	54	58
Nevada				70	80	85	72	70	69	83
Idaho	48	46	50	53	53	52	63	48	50	58
Washington	45	44	39	41	46	50	49	47	49	58
Oregon	49	50	42	49	52	59	59	52	52	57
California	65	50	43	41	63	61	60	59	54	78
General average	41.3	40.3	40.8	45.2	45.9	45.6	42.0	40.3	41.5	66.6

Average yield of barley in countries named, bushels per acre, 1897–1906.

Year.	United States.[a]	Russia, European.[b]	Germany.[b]	Austria.[b]	Hungary proper.[b]	France.[a]	United Kingdom.[a]
1897	24.5	11.7	29.0	17.6	17.6	19.4	34.0
1898	21.6	14.9	32.2	22.0	23.6	23.3	37.4
1899	25.5	10.9	33.8	24.9	24.0	22.7	35.8
1900	20.4	11.5	33.4	20.2	20.9	21.8	32.7
1901	25.6	11.2	33.2	22.4	20.0	21.1	32.7
1902	29.0	15.6	35.0	24.6	24.7	24.5	37.0
1903	26.4	15.5	36.3	24.8	25.1	25.2	33.4
1904	27.2	14.4	33.7	22.8	19.8	22.0	32.3
1905	26.8	14.3	33.2	24.0	24.5	23.4	35.9
1906	28.3	14.1	35.2	26.1	26.8	20.8	36.2
Average	25.5	13.4	33.5	22.9	22.7	22.4	34.3

[a] Winchester bushels. [b] Bushels of 48 pounds.

Wholesale prices of barley per bushel, 1903–1907.

Date.	Cincinnati.		Chicago.		St. Louis.		Milwaukee.		San Francisco.	
	Extra No. 3 spring.		No. 3.		Malting, medium to choice.		Extra No. 3.		No. 1 feed (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	55	65	45	58	50	61	49	61	$1.15	$1.21¼
February	56	65	47	56	50	61	48	63	1.15	1.22½
March	56	65	46	55	50	61	48	56	1.11¼	1.20
April	55	62	46	55	48	57	48	56	1.05	1.16¼
May	55	62	48	56	48	57	49	55½	1.05	1.12¼
June	55	62	49	54	......	......	49	53½	.90	1.12½
July	......	......	47	53	......	......	46	53	.97½	1.10
August	......	......	47	57	......	......	50	60	1.02½	1.13¾
September	62	71	51	63	55	67	52	63	1.08¾	1.16¼
October	61	69	46	62	54	65	50	62½	1.08¾	1.16¼
November	62	69	43	61½	50	64	49	61½	1.11½	1.15
December	60	69	42	61½	49	63	48	59½	1.07½	1.15
1904.										
January	60	69	37	61	48	65	50	61	1.10	1.13¾
February	62	69	40	61	50	65	49	61	1.07½	1.15
March	62	69	40	54	48	64	48	60	1.06¼	1.15
April	62	69	38	60	49	62	50	61	1.07½	1.15
May	62	69	38	59	......	......	50	61	1.03¾	1.10
June	62	69	35	59	......	......	47	60	.95	1.06¼
July	......	......	36	55	......	......	47	60	.95	1.03¾
August	......	......	38	55	42	48	42½	56	1.03¾	1.10
September	......	......	38	55	50	59	45	56	1.05	1.12½
October	55	62	37	54	45	59	41	53½	1.07½	1.12½
November	55	60	38	53	45	54	43	53	1.07½	1.13¾
December	55	60	38	52	44	54	41	51	1.10	1.15
1905.										
January	52	58	38	50	44	53	43	51	1.16¼	1.23¾
February	52	58	37	48	45	53	44	50	1.22½	1.25
March	52	58	40	48	45	51	43½	50	1.22½	1.30
April	52	58	40	49½	47	48	43½	50	1.22½	1.30
May	54	58	40	50	......	......	45	50	1.22½	1.35
June	54	58	43	50	......	......	45	51	1.27½	1.35
July	54	58	40	52	......	......	45	52	1.10	1.30
August	54	58	37½	50	......	......	44	52	1.02½	1.10
September	54	58	37½	52	48	55	42	53½	1.05	1.13¾
October	54	58	36½	53	43	55	43½	54	1.10	1.30
November	54	58	37½	55	43	56	41	54	1.22½	1.27½
December	54	58	37	53	45	54	44	54	1.22½	1.27½
1906.										
January	53	58	38½	55	46	53½	44	54	......	......
February	53	58	38	51	45	52	45	54	......	......
March	53	58	39	53	45	53½	43½	54	......	......
April	55	60	39	53	*a* 41½	*a* 42	45	55	......	......
May	55	60	42	55½	*a* 46	*a* 47	45	54	......	......
June	55	60	43	58	*a* 47	*a* 51	48	56	......	......
July	55	60	40	54	*a* 41	*a* 45	45½	55	......	......
August	......	......	38	53	*a* 36	*a* 38	46	54	......	......
September	52	61	38	55	46	57	45	54	......	......
October	52	61	40	56	45	58	46	55	......	......
November	56	62	42	56	46	58	46	55	......	......
December	57	62	44	56	49	58½	49	55	......	......
1907.									No. 1, brewing.	
January	54	60	45	57	50	59	49	57	1.15	1.20
February	57	68	48	63	55	67	52½	65	1.12½	1.20
March	67	71	57	75	63	75	63½	74½	1.15	1.27½
April	69	77	60	74	70	73	66	74½	1.20	1.27½
May	74	92	66	85	80	80	70	85	1.25	1.30
June	90	92	66	76	66	66	68½	79	1.22½	1.27½
July	90	92	55	75	65	65	62	70	1.22½	1.32½
August	88	92	55	87	......	......	63½	87	1.30	1.37½
September	88	113	76	100	88	100	83	108	1.37½	1.55
October	108	113	70	110	80	115	72	111	1.45	1.72½
November	108	113	58	95	71	95	80	100	1.62½	1.72½
December	108	113	78	102	84	102	85	100	1.60	1.67½

a Feed barley.

RYE.

Rye crop of countries named, 1903–1907.

Country.	1903.	1904.	1905.	1906.	1907.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	29,363,000	27,242,000	28,486,000	33,375,000	31,566,000
Canada:					
Ontario	3,064,000	2,065,000	1,769,000	1,369,000	1,116,000
Manitoba	51,000	130,000	179,000	104,000	86,000
Other	800,000	800,000	800,000	800,000	800,000
Total Canada	3,915,000	2,995,000	2,748,000	2,273,000	2,002,000
Mexico	136,000	67,000	70,000	70,000	70,000
Total North America	33,414,000	30,304,000	31,304,000	35,718,000	33,638,000
EUROPE.					
Austria-Hungary:					
Austria	81,130,000	91,685,000	98,186,000	99,246,000	86,445,000
Hungary proper	47,355,000	43,880,000	50,544,000	51,962,000	39,445,000
Croatia-Slavonia	3,386,000	2,038,000	2,537,000	1,919,000	3,000,000
Bosnia-Herzegovina	396,000	360,000	374,000	388,000	344,000
Total Austria-Hungary	132,267,000	137,963,000	151,641,000	153,515,000	129,234,000
Belgium	21,756,000	21,990,000	21,349,000	20,569,000	21,000,000
Bulgaria	7,750,000	7,772,000	7,541,000	10,818,000	8,000,000
Denmark	19,305,000	16,546,000	19,245,000	18,823,000	19,000,000
Finland	10,598,000	10,362,000	11,552,000	11,000,000	11,000,000
France	57,951,000	52,141,000	58,116,000	50,429,000	58,578,000
Germany	389,923,000	396,075,000	378,204,000	378,948,000	384,150,000
Italy	4,000,000	3,000,000	4,000,000	4,000,000	4,000,000
Netherlands	13,973,000	13,517,000	13,742,000	13,938,000	14,000,000
Norway	857,000	717,000	982,000	963,000	800,000
Roumania	7,145,000	2,201,000	7,344,000	8,900,000	2,554,000
Russia:					
Russia proper	803,296,000	893,205,000	629,671,000	555,698,000	....
Poland	69,100,000	76,606,000	69,088,000	74,100,000	....
Northern Caucasia	7,487,000	8,170,000	9,933,000	8,877,000	....
Total Russia (European)	879,883,000	977,981,000	708,692,000	638,675,000	776,000,000
Servia	1,091,000	1,031,000	1,103,000	1,560,000	911,000
Spain	22,511,000	17,276,000	26,502,000	31,828,000	27,027,000
Sweden	23,360,000	20,708,000	24,393,000	25,915,000	21,597,000
United Kingdom	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Total Europe	1,594,370,000	1,681,280,000	1,436,406,000	1,371,881,000	1,479,851,000
ASIA.					
Russia:					
Central Asia	1,066,000	1,088,000	690,000	404,000	....
Siberia	30,982,000	29,360,000	28,043,000	27,752,000	....
Transcausasia (*a*)	11,000	9,000	17,000	13,000	....
Total Russia (Asiatic)	32,059,000	30,457,000	28,750,000	28,169,000	32,000,000
Total Asia	32,059,000	30,457,000	28,750,000	28,169,000	32,000,000
AUSTRALASIA.					
Australia:					
Queensland	7,000	2,000	1,000	1,000	3,000
New South Wales	35,000	83,000	35,000	51,000	50,000
Victoria	22,000	31,000	32,000	30,000	21,000
Western Australia	5,000	4,000	5,000	4,000	5,000
Tasmania	9,000	11,000	12,000	8,000	10,000
Total Australia	78,000	131,000	85,000	94,000	89,000
New Zealand	40,000	21,000	33,000	65,000	43,000
Total Australasia	118,000	152,000	118,000	159,000	132,000
Grand total	1,659,961,000	1,742,193,000	1,496,578,000	1,435,927,000	1,545,621,000

a Includes Chernomorsk only.

Acreage, production, value, prices, and exports of rye in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Chicago cash price per bushel, No. 2.				Domestic exports including rye flour, fiscal year beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1850 [a]			14,188,813							
1860 [a]			21,101,380							
1866	1,548,033	13.5	20,864,944	82.2	17,149,716			142	150	234,971
1867	1,689,175	13.7	23,184,000	100.4	23,280,584	132	157	173	185	564,901
1868	1,651,321	13.6	22,504,800	94.9	21,349,190	106½	118	100	115½	92,869
1869	1,657,584	13.6	22,527,900	77.0	17,341,861	66	77½	78	83½	199,450
1870	1,176,137	13.2	15,473,600	73.2	11,326,967	67	74	81	91	87,174
1871	1,069,531	14.4	15,365,500	71.1	10,927,623	62	63¾	75	93	832,689
1872	1,048,654	14.2	14,888,600	67.6	10,071,061	57½	70	68½	70	611,749
1873	1,150,355	13.2	15,142,000	70.3	10,638,258	70	81	91	102	1,923,404
1874	1,116,716	13.4	14,990,900	77.4	11,610,339	93	99½	103	107½	267,058
1875	1,359,788	13.0	17,722,100	67.1	11,894,223	67	68¾	61½	70½	589,159
1876	1,468,374	13.9	20,374,800	61.4	12,504,970	65½	73	70	92½	2,234,856
1877	1,412,902	15.0	21,170,100	57.6	12,201,759	55½	56½	54	60	4,249,684
1878	1,622,700	15.9	25,842,790	52.5	13,566,002	44	44½	47	52	4,877,821
1879	1,625,450	14.5	23,639,460	65.6	15,507,431	73½	81	73½	85	2,943,894
1880	1,767,619	13.9	24,540,829	75.6	18,564,560	82	91½	115	118	1,955,155
1881	1,789,100	11.6	20,704,950	93.3	19,327,415	96½	98	77	83	1,003,609
1882	2,227,894	13.4	29,960,037	61.5	18,439,194	57	58½	62	67	2,206,212
1883	2,314,754	12.1	28,058,582	58.1	16,300,503	56½	60	60½	62½	6,247,590
1884	2,343,963	12.2	28,640,000	51.9	14,857,040	51	52	68	73	2,974,390
1885	2,129,301	10.2	21,756,000	57.9	12,594,820	58½	61	58	61	216,699
1886	2,129,918	11.5	24,489,000	53.8	13,181,330	53	54½	54½	56½	377,302
1887	2,053,447	10.1	20,693,000	54.5	11,283,140	55½	61½	63	68	94,827
1888	2,364,805	12.0	28,415,000	58.8	16,721,869	50	52	39	41½	309,266
1889	2,171,493	13.1	28,420,299	42.3	12,009,752	44	45½	49½	54	2,280,975
1890	2,141,853	12.0	25,807,472	62.9	16,229,992	64½	68½	83	92	358,263
1891	2,176,466	14.6	31,751,868	77.4	24,589,217	86	92	70¼	79	12,068,628
1892	2,163,657	12.9	27,894,037	54.2	15,103,901	46	51	50½	62	1,493,924
1893	2,038,485	13.0	26,555,446	51.3	13,612,222	45	47½	44½	48	249,152
1894	1,944,780	13.7	26,727,615	50.1	13,395,476	47½	49	62½	67	32,045
1895	1,890,345	14.4	27,210,070	44.0	11,964,826	32	35¾	33	36½	1,011,128
1896	1,831,201	13.3	24,369,047	40.9	9,960,769	37	42½	32¾	35½	8,575,663
1897	1,703,561	16.1	27,363,324	44.7	12,239,647	45¾	47	48	75	15,562,035
1898	1,643,207	15.6	25,657,522	46.3	11,875,350	52½	55½	56½	62	10,169,822
1899	1,659,308	14.4	23,961,741	51.0	12,214,118	49	52	53	56¼	2,382,012
1900	1,591,362	15.1	23,995,927	51.2	12,295,417	45¾	49¾	51½	54	2,345,512
1901	1,987,505	15.3	30,344,830	55.7	16,909,742	59	65¾	54½	58	2,712,077
1902	1,978,548	17.0	33,630,592	50.8	17,080,793	48	49¾	48	50½	5,445,273
1903	1,906,894	15.4	29,363,416	54.5	15,993,871	50½	52½	69¾	78	784,068
1904	1,792,673	15.2	27,241,515	68.8	18,748,323	73	75	70	84	29,749
1905	1,730,159	16.5	28,485,952	61.1	17,414,138	64	68	58	62	1,387,826
1906	2,001,904	16.7	33,374,833	58.9	19,671,243	61	65	69	87½	769,717
1907	1,926,000	16.4	31,566,000	73.1	23,068,000	75	82	79	86	

[a] Census figures.

Condition of the rye crop in the United States, monthly, 1888–1908.

Year.	December of previous year.	April.	May.	June.	July.	August.	When harvested.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1888	96.0	93.5	92.9	93.9	95.1	91.4	92.8
1889	97.2	93.9	96.5	95.2	96.7	95.4	91.6
1890	96.4	92.8	93.5	92.3	92.0	86.8	85.4
1891	99.0	95.4	97.2	95.4	93.9	89.6	95.1
1892	88.8	87.0	88.9	91.0	92.8	89.8	88.5
1893	89.4	85.7	82.7	84.6	85.3	78.5	82.0
1894	94.6	94.4	90.7	93.2	87.0	79.8	86.9
1895	96.2	87.0	88.7	85.7	80.7	84.0	83.7
1896	94.9	82.9	87.7	85.2	83.8	88.0	82.0
1897	99.8	88.9	88.0	89.9	93.4	89.8	90.1
1898	....	92 1	94.5	97.1	94.6	93.7	89.4
1899	98.9	84.9	85.2	84.5	84.9	89.0	82.0
1900	98.2	84.8	88.5	87.6	84.0	76.0	84.2
1901	99.1	93.1	94.1	93.9	93.5	83.6	84.9
1902	89.9	85.4	83.4	88.1	90.3	90.5	90.2
1903	98.1	97.9	93.3	90.6	89.3	87.2	84.1
1904	92.7	82.3	81.2	86.3	89.1	91.8	86.9
1905	90.5	92.1	93.5	95.3	92.9	92.6	90.8
1906	95.4	90.9	93.0	89.9	91.3	90.8	90.5
1907	96.2	92.0	88.0	88.1	89.7	88.9	....
1908	91.4	....	....	....	....	....	....

Acreage, production, and value of rye in the United States in 1907, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Vermont	1,800	17.0	30,000	78	23,000
Massachusetts	3,900	16.5	64,000	90	58,000
Connecticut	10,600	17.0	180,000	81	146,000
New York	128,400	16.5	2,119,000	81	1,716,000
New Jersey	78,400	17.5	1,372,000	76	1,043,000
Pennsylvania	346,300	16.7	5,783,000	75	4,337,000
Delaware	1,000	16.5	17,000	80	14,000
Maryland	19,700	16.0	315,000	75	236,000
Virginia	14,800	14.0	207,000	80	166,000
West Virginia	10,700	12.0	129,000	82	106,000
North Carolina	14,600	10.5	154,000	97	149,000
South Carolina	3,800	10.0	38,000	125	48,000
Georgia	14,500	9.0	130,000	125	163,000
Ohio	46,800	17.2	805,000	75	604,000
Indiana	56,600	17.0	961,000	72	692,000
Illinois	59,800	18.5	1,106,000	71	785,000
Michigan	376,000	14.5	5,452,000	72	3,925,000
Wisconsin	264,700	18.0	4,765,000	72	3,431,000
Minnesota	88,400	18.5	1,635,000	66	1,079,000
Iowa	53,200	17.8	947,000	64	606,000
Missouri	17,300	15.4	266,000	72	192,000
North Dakota	23,700	16.0	379,000	60	227,000
South Dakota	34,800	17.0	591,000	62	366,000
Nebraska	88,400	17.0	1,502,000	59	886,000
Kansas	51,300	12.0	615,000	66	406,000
Kentucky	9,100	13.7	125,000	86	108,000
Tennessee	8,200	10.0	82,000	88	72,000
Alabama	1,600	10.5	17,000	125	21,000
Texas	4,500	10.0	45,000	100	45,000
Oklahoma	2,300	10.0	23,000	74	17,000
Arkansas	1,700	9.9	17,000	90	15,000
Montana	2,100	22.0	47,000	68	32,000
Wyoming	400	21.5	9,000	66	6,000
Colorado	2,300	20.5	47,000	62	29,000
Utah	3,800	20.0	76,000	65	49,000
Idaho	1,700	24.7	41,000	63	26,000
Washington	2,900	21.5	62,000	77	48,000
Oregon	10,100	16.0	162,000	82	133,000
California	65,800	19.0	1,251,000	85	1,063,000
United States	1,926,000	16.4	31,566,000	73.1	23,068,000

Average yield per acre of rye in the United States, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	18.0	15.0	17.2	......	......	......	......	......	......	......
New Hampshire	17.5	15.0	17.1	......	......	......	......	......	......	......
Vermont	19.1	17.0	16.6	18.3	16.9	19.4	16.9	15.0	17.4	17.0
Massachusetts	16.7	16.0	16.9	15.9	15.2	13.7	17.0	15.5	15.0	16.5
Connecticut	18.0	18.0	17.0	18.0	17.4	17.0	16.9	18.0	18.0	17.0
New York	17.5	16.0	15.1	14.9	17.5	15.2	14.8	16.0	17.6	16.5
New Jersey	15.5	15.0	15.9	15.0	16.4	13.8	17.5	18.0	17.2	17.5
Pennsylvania	16.1	15.0	15.3	15.9	16.0	15.6	15.5	17.0	17.4	16.7
Delaware	......	......	......	15.3	13.5	14.8	11.8	10.0	15.0	16.5
Maryland	14.5	14.0	16.5	14.4	14.0	13.7	14.8	14.5	14.7	16.0
Virginia	11.2	9.0	10.5	11.1	9.6	12.2	15.7	11.8	13.4	14.0
West Virginia	11.2	10.0	10.5	12.0	8.1	11.5	12.5	11.8	12.2	12.0
North Carolina	9.1	7.0	8.9	8.5	8.2	8.8	9.9	9.5	11.0	10.5
South Carolina	8.5	5.0	7.5	7.7	7.6	7.6	7.5	8.1	8.5	10.0
Georgia	8.0	6.0	7.0	7.6	6.3	7.9	8.3	7.7	8.3	9.0
Ohio	17.4	16.0	16.6	16.9	17.5	15.3	16.1	18.0	19.5	17.2
Indiana	15.5	13.0	15.1	14.5	14.5	12.6	14.6	15.4	17.0	17.0
Illinois	14.8	15.0	17.2	17.0	19.1	16.5	17.6	18.0	17.0	18.5
Michigan	15.3	14.0	14.6	14.0	17.9	15.5	13.2	16.0	14.5	14.5
Wisconsin	15.3	15.0	15.8	15.9	18.9	16.6	16.2	16.5	17.0	18.0
Minnesota	20.5	18.0	19.5	19.3	22.3	18.4	17.7	18.2	19.3	18.5
Iowa	19.0	18.0	18.0	18.4	17.4	16.9	17.2	17.5	18.6	17.8
Missouri	13.1	13.0	14.0	14.2	18.2	12.8	14.4	15.5	15.8	15.4
North Dakota	15.0	15.0	5.2	13.8	20.2	15.7	18.5	19.5	18.7	16.0
South Dakota	16.6	15.0	10.6	14.4	18.8	20.2	16.5	19.0	18.8	17.0
Nebraska	18.8	16.0	14.2	15.0	20.3	14.2	15.8	18.0	21.0	17.0
Kansas	15.6	11.0	15.2	14.3	12.0	16.2	13.2	15.7	16.0	12.0
Kentucky	13.0	10.0	13.1	14.0	13.4	11.6	13.7	15.0	15.2	13.7
Tennessee	10.5	9.0	11.0	11.3	11.0	13.4	11.7	12.1	13.0	10.0
Alabama	11.1	8.0	7.8	8.0	10.0	10.6	10.4	11.7	12.5	10.5
Texas	12.0	10.0	16.5	11.1	9.9	14.2	13.1	14.0	14.6	10.0
Oklahoma	......	......	......	14.8	16.0	17.9	9.4	12.1	13.9	10.0
Arkansas	11.4	11.0	11.5	8.7	12.3	9.7	11.1	12.0	12.0	9.9
Montana	......	......	......	26.7	25.0	24.6	19.9	20.0	20.5	22.0
Wyoming	......	......	......	24.0	18.0	18.0	19.5	23.0	19.0	21.5
Colorado	18.0	14.0	16.8	16.1	15.9	18.3	19.1	19.0	20.0	20.5
Utah	19.5	17.0	17.5	14.2	12.4	16.1	16.0	18.0	24.0	20.0
Idaho	......	......	......	15.0	20.2	18.5	19.7	25.0	25.2	24.7
Washington	18.0	16.0	16.3	17.5	17.8	21.0	19.0	18.5	19.6	21.5
Oregon	14.4	11.0	16.1	15.7	13.4	14.2	14.4	15.0	17.2	16.0
California	9.0	15.0	13.0	12.8	12.0	12.3	7.6	13.0	12.8	19.0
General average	15.6	14.4	15.1	15.3	17.0	15.4	15.2	16.5	16.7	16.4

Average farm value per acre of rye in the United States, December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$15.12	$12.60	$14.10	......	......	......	......	......	......	......
New Hampshire	13.12	12.15	14.02	......	......	......	......	......	......	......
Vermont	11.08	10.54	10.13	$14.64	$13.01	$12.61	$12.51	$9.75	$10.79	$12.78
Massachusetts	10.52	12.64	12.68	12.56	12.16	10.00	13.94	12.25	9.75	14.87
Connecticut	10.80	11.52	11.05	12.96	13.05	12.07	13.35	13.32	11.88	13.77
New York	8.75	8.96	8.46	9.24	10.15	9.27	10.80	10.72	11.44	13.36
New Jersey	7.75	8.25	8.74	8.85	10.00	8.83	12.25	11.88	10.49	13.30
Pennsylvania	7.57	7.65	8.11	9.54	8.48	9.67	11.01	11.05	11.14	12.52
Delaware	......	......	......	8.87	8.37	9.03	8.61	6.60	9.60	14.00
Maryland	7.83	7.98	8.58	8.06	8.12	8.08	11.25	9.43	8.82	11.98
Virginia	5.15	4.77	6.09	6.77	6.34	8.05	11.62	8.38	9.38	11.22
West Virginia	5.82	6.20	6.72	78.0	5.51	8.17	9.63	8.26	8.54	9.91
North Carolina	5.82	5.25	6.76	6.63	6.97	7.39	8.61	8.17	9.35	10.21
South Carolina	8.67	5.45	7.87	8.55	8.59	8.13	9.45	9.64	10.63	12.63
Georgia	7.84	6.72	7.21	8.06	6.93	9.01	8.47	8.39	8.72	11.24
Ohio	7.83	8.80	9.13	9.30	9.27	8.87	11.91	11.16	11.12	12.91
Indiana	6.67	6.24	7.55	7.68	6.67	6.68	10.07	9.24	9.86	12.23
Illinois	6.51	7.05	8.08	9.69	9.55	8.58	12.32	10.80	9.52	13.13
Michigan	6.58	7.28	7.01	7.28	8.77	7.90	9.50	9.44	8.56	10.44
Wisconsin	6.58	7.20	7.74	8.27	9.45	8.30	11.18	9.73	9.86	12.96
Minnesota	7.79	7.56	8.19	9.46	9.59	8.28	11.33	9.65	9.65	12.21
Iowa	7.60	7.20	7.38	9.20	7.31	7.44	10.32	9.27	9.30	11.39
Missouri	6.16	6.50	7.14	9.51	8.74	7.04	9.22	9.61	9.48	11.10
North Dakota	5.40	5.55	2.13	5.93	8.69	6.75	11.10	9.75	8.79	9.58
South Dakota	5.64	5.55	4.13	6.19	7.71	8.08	9.41	9.31	8.46	10.52
Nebraska	6.39	6.08	5.68	6.90	7.31	5.25	8.69	8.64	9.24	10.02
Kansas	5.77	4.62	6.54	7.87	5.40	7.13	8.58	8.48	8.00	7.91
Kentucky	7.15	7.00	8.25	9.38	8.31	8.00	10.96	10.65	10.64	11.87
Tennessee	5.56	6.03	7.48	8.36	8.03	9.92	9.24	9.32	9.62	8.78
Alabama	11.65	8.32	8.03	8.32	10.50	11.45	12.48	13.34	13.12	13.12
Texas	8.52	8.20	11.05	10.32	7.52	10.51	11.27	11.90	12.41	10.00
Oklahoma	......	......	......	10.36	7.52	8.95	5.83	7.50	7.92	7.39
Arkansas	7.41	8.14	8.28	7.74	8.98	8.15	9.77	11.16	9.96	8.82
Montana	......	......	......	16.02	16.00	15.50	15.32	13.00	13.53	15.24
Wyoming	......	......	......	19.20	9.00	12.42	7.80	14.26	13.68	15.00
Colorado	9.00	6.72	9.07	9.98	8.90	11.16	12.41	10.64	11.20	12.61
Utah	8.97	8.16	9.10	9.23	7.56	10.46	10.72	11.70	15.60	12.89
Idaho	......	......	......	10.05	12.12	12.02	14.77	14.00	15.12	15.29
Washington	10.44	9.60	9.45	10.85	11.39	15.12	15.01	12.95	12.74	16.55
Oregon	10.37	7.70	9.82	10.36	9.78	13.77	12.82	12.15	12.73	13.17
California	6.30	11.70	7.54	7.30	9.00	9.47	5.93	10.01	9.09	16.16
General average	7.23	7.36	7.73	8.51	8.63	8.39	10.46	10.07	9.83	11.98

Average farm price of rye per bushel in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	84	84	82	..	..	..	..	..	..	..
New Hampshire	75	81	82	..	..	..	..	..	..	..
Vermont	58	62	61	80	77	65	74	65	62	78
Massachusetts	63	79	75	79	80	73	82	79	65	90
Connecticut	60	64	65	72	75	71	79	74	66	81
New York	50	56	56	62	58	61	73	67	65	81
New Jersey	50	55	55	59	61	64	70	66	61	76
Pennsylvania	47	51	53	60	53	62	71	65	64	75
Delaware	..	..	..	58	62	61	73	66	64	80
Maryland	54	57	52	56	58	59	76	65	60	75
Virginia	46	53	58	61	66	66	74	71	70	80
West Virginia	52	62	64	65	68	71	77	70	70	82
North Carolina	64	75	76	78	85	84	87	86	85	97
South Carolina	102	109	105	111	113	107	126	119	125	125
Georgia	98	112	103	106	110	114	102	109	105	125
Ohio	45	55	55	55	53	58	74	62	57	75
Indiana	43	48	50	53	46	53	69	60	58	72
Illinois	44	47	47	57	50	52	70	60	56	71
Michigan	43	52	48	52	49	51	72	59	59	72
Wisconsin	43	48	49	52	50	50	69	59	58	72
Minnesota	38	42	42	49	43	45	64	53	50	66
Iowa	40	40	41	50	42	44	60	53	50	64
Missouri	47	50	51	67	48	55	64	62	60	72
North Dakota	36	37	41	43	43	43	60	50	47	60
South Dakota	34	37	39	43	41	40	57	49	45	62
Nebraska	34	38	40	46	36	37	55	48	44	59
Kansas	37	42	43	55	45	44	65	54	50	66
Kentucky	55	70	63	67	62	69	80	71	70	86
Tennessee	53	67	68	74	73	74	79	77	74	88
Alabama	105	104	103	104	105	108	120	114	105	125
Texas	71	82	67	93	76	74	86	85	85	100
Oklahoma	..	..	..	70	47	50	62	62	57	74
Arkansas	65	74	72	89	73	84	88	93	83	90
Montana	..	..	..	60	64	63	77	65	66	68
Wyoming	..	..	..	80	50	69	40	62	72	66
Colorado	50	48	54	62	56	61	65	56	56	62
Utah	46	48	52	65	61	65	67	65	65	65
Idaho	..	..	..	67	60	65	75	56	60	63
Washington	58	60	58	62	64	72	79	70	65	77
Oregon	72	70	61	66	73	97	89	81	74	82
California	70	78	58	57	75	77	78	77	71	85
General average	46.3	51.0	51.2	55.7	50.8	54.5	68.8	61.1	58.9	73.1

Average yield of rye in countries named, bushels per acre, 1897–1906.

Year.	United States.[a]	Russia, European.[b]	Germany.[b]	Austria.[b]	Hungary proper.[b]	France.[a]	Ireland.[b]
1897	16.1	9.2	21.8	13.9	13.5	13.4	21.7
1898	15.6	10.6	24.2	17.7	16.9	18.3	25.5
1899	14.4	12.8	23.5	18.7	17.7	18.2	25.8
1900	15.1	12.7	22.9	13.0	15.1	16.9	25.7
1901	15.3	10.3	22.4	16.9	15.8	16.7	27.3
1902	17.0	12.5	24.6	18.2	19.1	14.3	28.1
1903	15.4	12.2	26.2	18.2	18.2	18.1	26.9
1904	15.2	13.7	26.3	19.3	17.1	16.6	26.0
1905	16.5	10.1	24.9	20.2	19.4	18.5	27.0
1906	16.7	8.8	25.1	19.9	19.8	16.3	27.6
Average	15.7	11.3	24.2	17.6	17.3	16.7	26.2

[a] Winchester bushels. [b] Bushels of 56 pounds.

Wholesale prices of rye per bushel, 1903–1907.

Date.	Philadelphia.		Cincinnati.		Chicago.		Duluth.		San Francisco (per cwt.).	
			No. 2.		No. 2.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	57	61½	55½	59	48	50¼	48	49	$1.12½	$1.15
February	61	65½	57½	58½	48¾	51½	48	49	1.12½	1.17
March	61	63½	56	58½	48¾	51½	49	49½	1.10	1.17½
April	59	60¾	55	58	48	51	49	50½	1.10	1.15
May	58	60	54	58	48	50½	49½	50	1.10	1.15
June	56	58	57	58	49	53¾	50	52	1.10	1.16¼
July	58½	60¼	56	57½	49½	51½	48½	50½	1.15	1.20
August	......	......	55	60	50½	53½	50½	52½	1.17½	1.25
September	62	65½	59½	63	53	60	50½	55¼	1.20	1.30
October	64	66	61	63	53	56½	52	54	1.25	1.30
November	63½	68	58	62	51½	58¼	52	54	1.25	1.30
December	67½	68½	59	62½	50½	52½	51	52½	1.25	1.30
1904.										
January	69	72	61	64	51	57	54½	57	1.25	1.30
February	72	74	63	81	56	77	58	73	1.27	1.35
March	......	......	76	80	66½	76	63	71	1.30	1.35
April	......	......	74	78	66	72	64	68½	1.30	1.35
May	......	......	75	80	69¾	78	65	69	1.30	1.35
June	78	80	76	80	63½	75	55	67	1.30	1.35
July	65	72	73	78	63	75	55	80	1.25	1.30
August	......	......	70	76½	62	76	62	75	1.25	1.32½
September	85	87½	75	83	69½	75	72	77	1.27½	1.40
October	88½	96	81	87	75	79½	77	79¼	1.37½	1.40
November	89	91	83	87	76	81	74	80	1.37½	1.45
December	80½	87½	81	86	73	75	71	74	1.40	1.47½
1905.										
January	81	87½	80	86	74½	75½	72½	75	1.42½	1.50
February	80	90¼	81½	86	74	78	73	75	1.45	1.60
March	80	83½	84	87	75	78½	73½	78	1.50	1.60
April	79½	83	80	86	73	78½	74	77	1.50	1.65
May	......	......	80	83	70	84	70	78	1.55	1.65
June	72	75	80	83	75	79	70	78	1.60	1.75
July	63	66	60	83	58	75	57½	72	1.40	1.50
August	65¾	69½	56	60	57½	60	55½	58	1.47½	1.52½
September	70	76½	56	66	60	72	59	64	1.50	1.52½
October	73¼	76	67	74	67	73½	63	65	1.45	1.52½
November	68	73	70	74½	66	72½	62	66½	1.45	1.47½
December	66½	73	70	72	64	68	62	60	1.45	1.50
1906.										
January	65	67	68	70½	65	68	60	60	......	......
February	63	65	65	70	63	65	60	61	......	......
March	58½	63	66	70	58½	63	56	59	......	......
April	58	62½	66	70	58	62½	56	57	......	......
May	58	62	66	69	58	62	57	57	......	......
June	60	61½	62	69	60	62	57	57	......	......
July	56	60	58	64	56	60	53	57	......	......
August	55½	56½	58	62	55½	56½	53	53	......	......
September	55½	62	60	66	55½	63	53	56	......	......
October	62	62½	65	68½	60	62½	56	59½	......	......
November	60	65	66½	72	60	65	58	61	......	......
December	61	65	69	72½	61	65	60	61	......	......
1907.										
January	75	77	68	71	60	63	57	60	1.42½	1.47½
February	75	80	69	73	64	70	60	60	1.35	1.42½
March	75	80	71	74	64	70	60	60½	1.35	1.45
April	77	82	73	75	67	72	60	64	1.40	1.50
May	79	89	73	84	69	87½	64	78	1.40	1.50
June	93	98	81	88	84	88¾	80	82½	1.40	1 50
July	93	98	80	88	83	88	74	80	1.45	1.50
August	75	86	79	88	69	86	66	74	1.42½	1.50
September	90	95	84	91	85	91¼	75	85	1.40	1.47½
October	80	100	81	93	72	90	75	86	1.37½	1.45
November	85	95	79	84	75	80	67	76	1.40	1.45
December	85	95	78	84	75	82	70	76	1.40	1.52½

BUCKWHEAT.

Acreage, production, and value of buckwheat in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1850 [a]			8,956,912		
1860 [a]			17,571,818		
1866	1,045,624	21.8	22,791,839	67.6	15,413,160
1867	1,227,826	17.4	21,359,000	78.7	16,812,070
1868	1,113,993	17.8	19,863,700	78.0	15,490,426
1869	1,028,693	16.9	17,431,100	71.9	12,534,851
1870	536,992	18.3	9,841,500	70.5	6,937,471
1871	413,915	20.1	8,328,700	74.5	6,208,165
1872	448,497	18.1	8,133,500	73.5	5,979,222
1873	454,152	17.3	7,837,700	75.0	5,878,629
1874	452,590	17.7	8,016,600	72.9	5,843,645
1875	575,530	17.5	10,082,100	62.0	6,254,564
1876	666,441	14.5	9,668,800	66.6	6,435,836
1877	649,923	15.7	10,177,000	66.9	6,808,180
1878	673,100	18.2	12,246,820	52.6	6,441,240
1879	639,900	20.5	13,140,000	59.8	7,856,191
1880	822,802	17.8	14,617,535	59.4	8,682,488
1881	828,815	11.4	9,486,200	86.5	8,205,705
1882	847,112	13.0	11,019,353	73.0	8,038,862
1883	857,349	8.9	7,668,954	82.2	6,303,980
1884	879,403	12.6	11,116,000	58.9	6,549,020
1885	914,394	13.8	12,626,000	55.9	7,057,363
1886	917,915	12.9	11,869,000	54.5	6,465,120
1887	910,506	11.9	10,844,000	56.5	6,122,320
1888	912,630	13.2	12,050,000	63.3	7,627,647
1889	837,162	14.5	12,110,329	50.5	6,113,119
1890	844,579	14.7	12,432,831	57.4	7,132,872
1891	849,364	15.0	12,760,932	57.0	7,271,506
1892	861,451	14.1	12,143,185	51.8	6,295,643
1893	815,614	14.9	12,122,311	58.4	7,074,450
1894	789,232	16.1	12,668,200	55.6	7,040,238
1895	763,277	20.1	15,341,399	45.2	6,936,325
1896	754,898	18.7	14,089,783	39.2	5,522,339
1897	717,836	20.9	14,997,451	42.1	6,319,188
1898	678,332	17.3	11,721,927	45.0	5,271,462
1899	670,148	16.6	11,094,473	55.7	6,183,675
1900	637,930	15.0	9,566,966	55.8	5,341,413
1901	811,164	18.6	15,125,939	56.3	8,523,317
1902	804,889	18.1	14,529,770	59.6	8,654,704
1903	804,393	17.7	14,243,644	60.7	8,650,733
1904	793,625	18.9	15,008,336	62.2	9,330,768
1905	760,118	19.2	14,585,082	58.7	8,565,499
1906	789,208	18.6	14,641,937	59.6	8,727,443
1907	800,000	17.9	14,290,000	69.8	9,975,000

[a] Census figures.

Condition of the buckwheat crop in the United States, monthly, 1887–1907.

Year.	Aug.	Sept.	When harvested.	Year.	Aug.	Sept.	When harvested.	Year.	Aug.	Sept.	When harvested.
	P. ct.	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*
1887	93.3	89.1	76.6	1894	82.3	69.2	72.0	1901	91.1	90.9	90.5
1888	92.5	93.7	79.1	1895	85.2	87.5	84.8	1902	91.4	86.4	80.5
1889	95.2	92.1	90.0	1896	96.0	93.2	86.0	1903	93.9	91.0	83.0
1890	90.1	90.5	90.7	1897	94.9	95.1	90.8	1904	92.8	91.5	88.7
1891	97.3	96.6	92.7	1898	87.2	88.8	76.2	1905	92.6	91.8	91.6
1892	92.9	89.0	85.6	1899	93.2	75.2	70.2	1906	93.2	91.2	84.9
1893	88.8	77.5	73.5	1900	87.9	80.5	72.8	1907	91.9	77.4	80.1

Acreage, production, and value of buckwheat in the United States in 1907, by States.

State.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	23,000	28.0	644,000	65	419,000
New Hampshire	2,000	22.0	44,000	75	33,000
Vermont	8,000	22.0	176,000	70	123,000
Massachusetts	2,000	21.0	42,000	70	30,000
Connecticut	3,000	16.0	48,000	75	36,000
New York	325,000	17.5	5,687,000	70	3,981,000
New Jersey	12,000	16.5	198,000	75	149,000
Pennsylvania	257,000	18.0	4,626,000	69	3,192,000
Delaware	1,000	24.0	24,000	69	17,000
Maryland	9,000	19.0	171,000	67	115,000
Virginia	18,000	19.0	342,000	73	250,000
West Virginia	21,000	18.5	388,000	75	291,000
North Carolina	5,000	15.5	78,000	71	55,000
Ohio	13,000	19.5	254,000	75	191,000
Indiana	4,000	15.5	62,000	73	45,000
Illinois	4,000	17.0	68,000	80	54,000
Michigan	55,000	15.5	852,000	65	554,000
Wisconsin	20,000	16.0	320,000	72	230,000
Minnesota	5,000	14.7	74,000	73	54,000
Iowa	9,000	15.0	135,000	80	108,000
Missouri	1,000	16.0	16,000	90	14,000
Nebraska	1,000	14.5	14,000	88	12,000
Kansas	1,000	12.0	12,000	82	10,000
Tennessee	1,000	15.0	15,000	80	12,000
United States	800,000	17.9	14,290,000	69.8	9,975,000

Average yield per acre of buckwheat in the United States, 1898–1907, by States.

State.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	26.5	22.0	30.0	31.7	30.4	29.8	32.5	30.0	28.0	28.0
New Hampshire	20.0	20.0	22.0	21.0	20.0	19.6	25.1	23.0	22.0	22.0
Vermont	21.4	23.0	25.0	25.1	25.0	24.0	26.3	19.0	21.0	22.0
Massachusetts	20.0	20.0	17.0	18.9	14.4	13.7	16.2	20.0	20.0	21.0
Connecticut	19.0	19.0	16.0	18.0	18.4	17.5	16.3	16.0	17.0	16.0
New York	16.8	13.0	14.0	18.8	17.7	18.3	18.8	19.0	19.0	17.5
New Jersey	21.0	21.0	16.0	19.0	22.5	18.1	20.8	21.0	18.0	16.5
Pennsylvania	17.2	20.0	14.0	19.5	18.1	16.5	18.8	20.0	19.0	18.0
Delaware	16.5	18.0	13.0	17.8	15.2	15.2	12.1	17.0	17.0	24.0
Maryland	12.2	13.0	15.0	17.5	17.0	16.3	18.2	19.0	18.0	19.0
Virginia	17.3	14.0	13.0	15.9	16.6	18.6	17.0	18.0	19.0	19.0
West Virginia	20.5	17.0	17.0	20.6	22.5	17.2	19.1	19.0	18.0	18.5
North Carolina	19.5	17.0	13.0	15.6	14.5	12.1	14.7	15.0	14.0	15.5
Ohio	20.0	16.0	16.0	16.1	13.9	16.6	16.9	17.0	19.0	19.5
Indiana	18.4	16.0	14.0	13.1	17.6	16.8	16.1	17.0	16.0	15.5
Illinois	14.0	15.0	15.0	11.0	15.5	15.3	17.9	16.0	19.0	17.0
Michigan	14.2	11.0	14.0	14.1	13.0	15.5	15.4	16.0	13.0	15.5
Wisconsin	15.5	15.0	14.0	12.4	16.0	15.6	17.7	15.0	15.0	16.0
Minnesota	15.0	17.0	15.0	14.5	13.9	15.2	15.1	14.0	14.0	14.7
Iowa	16.0	16.0	15.0	13.5	16.0	15.1	14.8	13.0	12.0	15.0
Missouri	15.8	14.0	13.0	6.0	16.0	14.8	13.5	16.0	18.0	16.0
North Dakota	......	......	......	11.5	10.0	12.7	13.5	......	......	......
Nebraska	12.8	16.0	16.0	11.5	14.7	19.0	14.7	14.0	15.0	14.5
Kansas	......	......	......	7.9	12.0	18.4	14.0	11.0	17.0	12.0
Tennessee	18.0	12.0	14.0	14.2	18.0	14.7	15.5	16.0	16.0	15.0
Oregon	14.0	17.0	13.0	......	......	......	......	......	......	......
General average	17.3	16.6	15.0	18.6	18.1	17.7	18.9	19.2	18.6	17.9

Average farm value per acre of buckwheat in the United States December 1, 1898–1907, by States.

State.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$10.34	$9.68	$14.70	$15.22	$15.81	$15.20	$16.90	$19.50	$16.52	$18.22
New Hampshire	9.40	10.00	11.44	11.55	13.00	11.56	17.07	16.33	16.06	16.50
Vermont	9.84	11.96	12.50	14.81	14.00	13.20	14.73	9.69	12.18	15.38
Massachusetts	12.20	14.00	12.24	11.53	10.66	9.32	11.66	14.20	13.60	15.00
Connecticut	10.64	11.97	10.40	11.70	13.06	12.42	11.90	11.68	12.75	12.00
New York	7.56	7.67	7.98	10.72	10.44	10.80	11.47	11.21	11.59	12.25
New Jersey	11.34	11.76	9.44	9.88	14.40	11.58	13.73	13.23	10.80	12.42
Pennsylvania	7.57	10.80	7.70	10.92	11.04	10.56	11.84	11.20	10.83	12.42
Delaware	6.60	8.82	6.76	9.79	9.12	8.36	7.50	9.69	10.37	17.00
Maryland	6.47	7.28	8.55	10.50	10.37	10.27	11.47	11.97	10.80	12.78
Virginia	7.79	7.56	7.15	8.90	9.96	11.35	10.88	11.16	11.02	13.89
West Virginia	10.05	9.52	9.52	12.15	13.95	11.70	13.75	12.54	11.70	13.86
North Carolina	9.36	8.33	7.28	9.67	8.99	7.86	10.44	9.90	8.96	11.00
Ohio	10.20	9.28	9.28	9.66	8.48	10.79	12.17	10.54	10.83	14.69
Indiana	9.38	9.44	8.54	7.99	10.21	11.76	11.27	11.05	10.24	11.25
Illinois	7.28	8.70	9.75	7.70	11.01	11.17	13.96	10.88	14.25	13.50
Michigan	5.96	6.05	7.14	7.19	6.89	8.37	9.39	8.48	7.15	10.07
Wisconsin	6.20	9.45	8.26	7.32	9.44	9.52	11.15	8.40	9.30	11.50
Minnesota	7.35	8.84	8.55	8.99	7.92	8.06	9.06	7.98	7.56	10.80
Iowa	7.69	9.28	9.60	9.45	11.20	10.72	9.92	9.10	9.12	12.00
Missouri	9.48	8.54	8.97	4.56	9.34	11.10	11.48	13.12	13.32	14.00
North Dakota	......	......	......	6.90	5.40	6.73	9.45	......	......	......
Nebraska	7.81	9.92	10.24	6.67	7.79	13.11	13.38	8.82	9.30	12.00
Kansas	......	......	......	5.92	9.00	14.35	11.20	7.59	12.58	10.00
Tennessee	9.36	6.84	8.26	8.38	13.68	9.70	11.01	10.88	13.28	12.00
Oregon	8.12	12.58	10.01	......	......	......	......	......	......	......
General average	7.77	9.23	8.37	10.51	10.75	10.75	11.76	11.27	11.06	12.47

Average farm price of buckwheat per bushel in the United States December 1, 1898–1907, by States.

State.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	39	44	49	48	52	51	52	65	59	65
New Hampshire	47	50	52	55	65	59	68	71	73	75
Vermont	46	52	50	59	56	55	56	51	58	70
Massachusetts	61	70	72	61	74	68	72	71	68	70
Connecticut	56	63	65	65	71	71	73	73	75	75
New York	45	59	57	57	59	59	61	59	61	70
New Jersey	54	56	59	52	64	64	66	63	60	75
Pennsylvania	44	54	55	56	61	64	63	56	57	69
Delaware	40	49	52	55	60	55	62	57	61	69
Maryland	53	56	57	60	61	63	63	63	60	67
Virginia	45	54	55	56	60	61	64	62	58	73
West Virginia	49	56	56	59	62	68	72	66	65	75
North Carolina	48	49	56	62	62	65	71	66	64	71
Ohio	51	58	58	60	61	65	72	62	57	75
Indiana	51	59	61	61	58	70	70	65	64	73
Illinois	52	58	65	70	71	73	78	68	75	80
Michigan	42	55	51	51	53	54	61	53	55	65
Wisconsin	40	63	59	59	59	61	63	56	62	72
Minnesota	49	52	57	62	57	53	60	57	54	73
Iowa	48	58	64	70	70	71	67	70	76	80
Missouri	60	61	69	76	58	75	85	82	74	90
North Dakota	......	......	......	60	54	53	70	......	......	......
Nebraska	61	62	64	58	53	69	91	63	62	88
Kansas	......	......	......	75	75	78	80	69	74	82
Tennessee	52	57	59	59	76	66	71	68	83	80
Oregon	58	74	77	......	......	......	......	......	......	......
General average	45.0	55.7	55.8	56.3	59.6	60.7	62.2	58.7	59.6	69.8

POTATOES.

Potato crop of countries named, 1902–1906.

[No statistics for Switzerland, Portugal, Argentina, Transvaal, Egypt, and some other less important potato-growing countries.]

Country.	1902.	1903.	1904.	1905.	1906.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	284,633,000	247,128,000	332,830,000	260,741,000	308,038,000
Canada:					
Ontario	13,350,000	17,202,000	15,967,000	14,819,000	15,494,000
Manitoba	3,568,000	4,907,000	3,919,000	2,901,000	4,281,000
New Brunswick	4,288,000	4,835,000	5,550,000	5,693,000	5,522,000
Saskatchewan and Alberta	[a] 1,000,000	[a] 1,000,000	[a] 1,000,000	2,844,000	5,507,000
Other [a]	29,000,000	29,000,000	29,000,000	29,000,000	29,000,000
Total Canada	51,206,000	56,944,000	55,436,000	55,257,000	59,804,000
Mexico	347,000	539,000	527,000	[b] 400,000	[b] 400,000
Newfoundland [a]	1,350,000	1,350,000	1,350,000	1,350,000	1,350,000
Total North America	337,536,000	305,961,000	390,143,000	317,748,000	369,592,000
SOUTH AMERICA.					
Chile	11,616,000	10,349,000	6,131,000	6,532,000	[c] 6,532,000
EUROPE.					
Austria-Hungary:					
Austria	428,229,000	357,121,000	398,298,000	581,822,000	514,289,000
Hungary proper	141,538,000	165,386,000	110,402,000	168,221,000	179,083,000
Croatia-Slavonia	13,059,000	19,337,000	9,311,000	12,589,000	12,854,000
Bosnia-Herzegovina	1,793,000	2,322,000	2,450,000	2,485,000	3,011,000
Total Austria-Hungary	584,619,000	544,166,000	520,461,000	765,117,000	709,237,000
Belgium	83,198,000	86,580,000	91,632,000	57,159,000	88,652,000
Denmark	27,168,000	25,256,000	24,214,000	29,954,000	28,455,000
Finland	15,298,000	19,212,000	15,465,000	20,704,000	[c] 20,704,000
France	441,055,000	426,422,000	451,039,000	523,876,000	372,076,000
Germany	1,596,969,000	1,576,361,000	1,333,326,000	1,775,579,000	1,577,653,000
Italy [d]	29,000,000	29,000,000	29,000,000	29,000,000	29,000,000
Malta	361,000	628,000	733,000	387,000	378,000
Netherlands	94,756,000	73,394,000	94,421,000	87,043,000	95,503,000
Norway	17,735,000	22,851,000	17,253,000	25,832,000	20,995,000
Roumania	4,659,000	5,246,000	3,001,000	3,733,000	4,636,000
Russia:					
Russia proper	723,435,000	675,330,000	705,170,000	686,502,000	630,211,000
Poland	288,447,000	194,829,000	179,997,000	331,529,000	296,662,000
Northern Caucasia	16,154,000	17,441,000	8,741,000	14,857,000	12,844,000
Total Russia (European)	1,028,036,000	887,600,000	893,908,000	1,032,888,000	939,717,000
Servia	1,402,000	1,527,000	718,000	1,232,000	[c] 1,232,000
Spain [b]	84,000,000	84,000,000	84,000,000	84,000,000	84,000,000
Sweden	51,377,000	59,317,000	51,314,000	74,819,000	105,742,000
United Kingdom:					
Great Britain	119,250,000	108,779,000	133,961,000	140,474,000	128,005,000
Ireland	101,761,000	88,227,000	98,635,000	127,793,000	99,328,000
Total United Kingdom	221,011,000	197,006,000	232,596,000	268,267,000	227,333,000
Total Europe	4,280,644,000	4,038,566,000	3,843,081,000	4,779,590,000	4,305,313,000
ASIA.					
Japan	7,418,000	9,824,000	11,274,000	16,255,000	[c] 16,255,000
Russia (Asiatic)	13,142,000	19,364,000	18,800,000	18,865,000	16,481,000
Total Asia	20,560,000	29,188,000	30,074,000	35,120,000	32,736,000
AFRICA.					
Algeria	1,851,000	1,596,000	1,655,000	1,605,000	1,684,000
Cape of Good Hope	[e] 1,600,000	[e] 1,600,000	1,942,000	[a] 2,000,000	[a] 2,000,000
Natal	433,000	345,000	451,000	466,000	454,000
Total Africa	3,884,000	3,541,000	4,048,000	4,071,000	4,138,000

[a] Estimated from returns for census year.
[b] Average production.
[c] 1905 figures.
[d] Average 1896-1900.
[e] Estimated from statistics for 1899 and 1904.

Potato crop of countries named, 1902–1906—Continued.

Country.	1902.	1903.	1904.	1905.	1906.
AUSTRALASIA.					
Australia:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Queensland	836,000	122,000	659,000	718,000	422,000
New South Wales	1,461,000	1,147,000	2,118,000	1,820,000	1,881,000
Victoria	4,684,000	6,300,000	6,262,000	3,467,000	4,307.000
South Australia	562,000	1,057,000	1,173,000	729,000	759,000
Western Australia	214,000	242,000	170,000	210,000	235,000
Tasmania	4,282,000	6,105,000	6,395,000	4,127,000	2,412,000
Total Australia	12,039,000	14,973,000	16,777,000	11,071,000	10,016,000
New Zealand	7,721,000	7,215,000	7,795,000	5,025,000	4,607,000
Total Australasia	19,760,000	22,188,000	24,572,000	16,096,000	14,623,000
Grand total	4,674,000,000	4,409,793,000	4,298,049,000	5,159,157,000	4,732,934,000

Acreage, production, value, prices, exports, etc., of potatoes in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Chicago, price per bushel, Burbank. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal year beginning July 1.	Imports during fiscal year beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1850 a			65,797,896								
1860 a			111,148,867								
1866	1,069,381	100.2	107,200,976	47.3	50,722,553					512,380	198,265
1867	1,192,195	82.0	97,783,000	65.9	64,462,486					378,605	209,555
1868	1,131,552	93.8	106,090,000	59.3	62,918,660					508,249	138,470
1869	1,222,190	109.5	133,886,000	42.9	57,481,362					596,968	75,336
1870	1,325,119	86.6	114,775,000	65.0	74,621,019					553,070	458,758
1871	1,220,912	98.7	120,461,700	53.9	64,905,189					621,537	96,259
1872	1,331,331	85.3	113,516,000	53.5	60,692,129					515,306	346,840
1873	1,295,139	81.9	106,089,000	65.2	69,153,709					497,413	549,073
1874	1,310,041	80.9	105,981,000	61.5	65,223,314					609,642	188,757
1875	1,510,041	110.5	166,877,000	34.4	57,357,515					704,379	92,148
1876	1,741,983	71.7	124,827,000	61.9	77,319,541					529,650	3,205,555
1877	1,792,287	94.9	170,092,000	43.7	74,272,500					744,409	528,584
1878	1,776,800	69.9	124,126,650	58.7	72,923,575					625,342	2,624,149
1879	1,836,800	98.9	181,626,400	43.6	79,153,673					696,080	721,868
1880	1,842,510	91.0	167,659,570	48.3	81,062,214					638,840	2,170,372
1881	2,041,670	53.5	109,145,494	91.0	99,291,341					408,286	8,789,860
1882	2,171,636	78.7	170,972,508	55.7	95,304,844					439,443	2,362,362
1883	2,289,275	90.9	208,164,425	42.2	87,848,991					554,613	425,408
1884	2,220,980	85.8	100,642,000	39.6	75,524,290					380,868	658,633
1885	2,265,823	77.2	175,029,000	44.7	78,153,403			33	50	494,948	1,937,416
1886	2,287,136	73.5	168,051,000	46.7	78,441,940	44	47	65	90	434,864	1,432,490
1887	2,357,322	56.9	134,103,000	68.2	91,506,740	70	83	65	85	403,880	8,259,538
1888	2,533,280	79.9	202,365,000	40.2	81,413,589	30	37	24	45	471,955	883,380
1889	2,647,989	77.4	204,881,441	35.4	72,610,934	33	45	30	60	406,618	3,415,578
1890	2,651,579	55.9	148,289,696	75.8	112,341,708	82	93	95	110	341,189	5,401,912
1891	2,714,770	93.7	254,423,607	35.8	91,012,962	30	40	30	50	557,022	186,871
1892	2,547,962	61.5	156,654,819	66.1	103,567,520	60	72	70	98	845,720	4,317,021
1893	2,605,186	70.3	183,034,203	59.4	108,661,801	51	60	64	88	803,111	3,002,578
1894	2,737,973	62.4	170,787,338	53.6	91,526,787	43	58	40	70	572,957	1,341,533
1895	2,954,952	100.6	297,237,370	26.6	73,984,901	18	24	10	23	680,049	175,240
1896	2,767,465	91.1	252,234,540	28.6	72,182,350	18	26	19	26	926,646	246,178
1897	2,534,577	64.7	164,015,964	54.7	89,643,059	50	62	60	87	605,187	1,171,378
1898	2,557,729	75.2	192,306,338	41.4	79,574,772	30	36	33	52	579,833	530,420
1899	2,581,353	88.6	228,783,232	39.0	89,328,832	35	46	27	39	809,472	155,861
1900	2,611,054	80.8	210,926,897	43.1	90,811,167	40	48	35	60	741,483	371,911
1901	2,864,335	65.5	187,598,087	76.7	143,979,470	75	82	58	100	528,484	7,656,162
1902	2,965,587	96.0	284,632,787	47.1	134,111,436	42	48	42	60	843,075	358,505
1903	2,916,855	84.7	247,127,880	61.4	151,638,094	60	66	95	116	484,042	3,166,581
1904	3,015,675	110.4	332,830,300	45.3	150,673,392	32	38	20	25	1,163,270	181,199
1905	2,996,757	87.0	260,741,294	61.7	160,821,080	55	66	48	73	1,000,326	1,948,160
1906	3,013,150	102.2	308,038,382	51.1	157,547,392	40	43	55	75	1,528,461	176,917
1907	3,124,000	95.4	297,942,000	61.7	183,880,000	46	58				

a Census figures.

Condition of the potato crop in the United States, monthly, 1890–1907.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1890	91.7	77.4	65.7	61.7	1899	93.8	93.0	86.3	81.7
1891	95.3	96.5	94.8	91.3	1900	91.3	88.2	80.0	74.4
1892	90.0	86.8	74.8	67.7	1901	87.4	62.3	52.2	54.0
1893	94.8	86.0	71.8	71.2	1902	92.9	94.8	89.1	82.5
1894	92.3	74.0	62.4	64.3	1903	88.1	87.2	84.3	74.6
1895	91.5	89.7	90.8	87.4	1904	93.9	94.1	91.6	89.5
1896	99.0	94.8	83.2	81.7	1905	91.2	87.2	80.9	74.3
1897	87.8	77.9	66.7	61.6	1906	91.5	89.0	85.3	82.2
1898	95.5	83.9	77.7	72.5	1907	90.2	88.5	80.2	77.0

Acreage, production, and value of potatoes in the United States in 1907, by States.

State or Territory.	Average.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	118,000	145	17,110,000	56	9,582,000
New Hampshire	19,000	120	2,280,000	67	1,528,000
Vermont	26,000	120	3,120,000	53	1,654,000
Massachusetts	30,000	120	3,600,000	84	3,024,000
Rhode Island	6,000	110	660,000	93	614,000
Connecticut	32,000	100	3,200,000	77	2,464,000
New York	426,000	98	41,748,000	57	23,796,000
New Jersey	70,000	120	8,400,000	74	6,216,000
Pennsylvania	261,000	88	22,968,000	67	15,389,000
Delaware	8,000	99	792,000	65	515,000
Maryland	30,000	95	2,850,000	60	1,710,000
Virginia	56,000	80	4,480,000	68	3,046,000
West Virginia	34,000	83	2,822,000	80	2,258,000
North Carolina	23,000	88	2,024,000	78	1,579,000
South Carolina	9,000	70	630,000	110	693,000
Georgia	10,000	83	830,000	100	830,000
Florida	4,000	80	320,000	[a]95	304,000
Ohio	157,000	76	11,932,000	68	8,114,000
Indiana	84,000	87	7,308,000	65	4,750,000
Illinois	154,000	87	13,398,000	72	9,647,000
Michigan	299,000	90	26,910,000	45	12,109,000
Wisconsin	250,000	91	22,750,000	45	10,237,000
Minnesota	145,000	101	14,645,000	41	6,004,000
Iowa	141,000	85	11,985,000	55	6,592,000
Missouri	87,000	82	7,134,000	72	5,136,000
North Dakota	27,000	89	2,403,000	62	1,490,000
South Dakota	39,000	84	3,276,000	50	1,638,000
Nebraska	88,000	73	6,424,000	70	4,497,000
Kansas	87,000	65	5,655,000	88	4,976,000
Kentucky	37,000	80	2,960,000	75	2,220,000
Tennessee	22,000	85	1,870,000	76	1,421,000
Alabama	15,000	95	1,425,000	100	1,425,000
Mississippi	6,000	90	540,000	93	502,000
Louisiana	12,000	67	804,000	90	724,000
Texas	33,000	73	2,409,000	105	2,529,000
Oklahoma	28,000	70	1,960,000	100	1,960,000
Arkansas	25,000	70	1,750,000	91	1,592,000
Montana	18,000	150	2,700,000	50	1,350,000
Wyoming	5,000	200	1,000,000	74	740,000
Colorado	47,000	150	7,050,000	66	4,653,000
New Mexico	1,000	100	100,000	96	96,000
Utah	12,000	100	1,200,000	65	780,000
Nevada	3,000	200	600,000	90	540,000
Idaho	14,000	145	2,030,000	52	1,056,000
Washington	40,000	150	6,000,000	50	3,000,000
Oregon	42,000	125	5,250,000	56	2,940,000
California	48,000	145	6,960,000	90	6,264,000
United States	3,128,000	95.4	298,262,000	61.8	184,184,000

[a] Estimated.

Average yield per acre of potatoes in the United States, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	130	139	126	150	130	196	215	175	210	145
New Hampshire	90	127	101	108	120	98	135	120	112	120
Vermont	105	132	134	90	94	138	128	98	101	120
Massachusetts	97	134	79	77	109	96	119	97	114	120
Rhode Island	123	142	94	98	164	125	137	125	108	110
Connecticut	100	130	96	81	92	96	96	92	98	100
New York	73	88	81	78	66	89	93	70	105	98
New Jersey	75	83	69	59	132	99	115	93	120	120
Pennsylvania	54	85	58	62	83	91	106	90	94	88
Delaware	49	52	48	55	79	84	84	93	97	99
Maryland	58	64	55	60	80	70	99	95	93	95
Virginia	68	66	58	71	75	84	83	84	75	80
West Virginia	62	72	80	52	96	80	101	88	97	83
North Carolina	67	57	61	64	64	67	78	77	75	88
South Carolina	65	56	78	70	69	81	88	83	82	70
Georgia	54	46	68	64	58	73	70	65	77	83
Florida	64	69	60	62	90	82	102	75	85	80
Ohio	61	71	76	54	94	83	98	78	110	76
Indiana	71	76	83	31	101	76	93	80	89	87
Illinois	70	96	92	35	118	72	108	75	97	87
Michigan	79	66	97	81	72	78	121	67	95	90
Wisconsin	98	103	103	75	115	58	126	68	97	91
Minnesota	85	96	81	68	98	64	102	82	92	101
Iowa	80	100	72	32	98	56	136	80	95	85
Missouri	66	82	93	17	128	66	96	82	84	82
North Dakota	87	103	52	110	105	84	111	95	98	89
South Dakota	72	78	73	45	74	89	96	96	100	84
Nebraska	65	94	66	33	137	64	120	93	87	73
Kansas	70	95	72	26	138	58	80	81	79	65
Kentucky	64	51	70	35	80	73	83	85	82	80
Tennessee	52	44	54	46	62	66	71	80	80	85
Alabama	74	56	69	67	50	67	61	80	75	95
Mississippi	74	61	66	62	69	82	82	110	85	90
Louisiana	78	60	70	60	65	50	70	64	62	67
Texas	78	64	62	54	66	67	72	64	77	73
Indian Territory	......	......	......	63	85	70	69	76	76	70
Oklahoma	......	......	......	55	97	78	85	77	85	
Arkansas	74	63	72	46	72	70	77	65	80	70
Montana	104	141	134	157	153	176	143	120	152	150
Wyoming	120	125	99	113	100	167	161	170	115	200
Colorado	77	84	56	120	100	145	159	160	125	150
New Mexico	58	49	19	50	72	87	62	75	121	100
Utah	135	120	118	114	157	177	137	132	165	100
Nevada	155	102	156	141	212	117	131	120	175	200
Idaho	120	124	136	108	149	160	139	140	175	145
Washington	108	144	116	117	136	145	120	142	129	150
Oregon	86	115	110	90	103	107	87	110	101	125
California	95	119	104	101	118	130	129	165	125	145
General average	75.2	88.6	80.8	65.5	96.0	84.7	110.4	87.0	102.2	95.4

Average farm value per acre of potatoes in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$59.80	$58.38	$61.74	$100.50	$84.50	$109.76	$103.20	$106.75	$105.00	$81.20
New Hampshire	44.10	58.42	53.53	85.32	82.80	63.70	75.60	86.40	67.20	80.42
Vermont	44.10	47.52	53.60	57.60	54.52	69.00	60.16	69.58	55.55	63.62
Massachusetts	61.11	76.38	52.14	69.30	88.29	68.16	84.49	81.48	74.10	100.80
Rhode Island	78.72	71.00	65.80	91.14	123.00	102.50	104.12	111.25	86.40	102.33
Connecticut	55.00	59.80	67.20	76.14	67.16	74.88	69.12	83.72	70.56	77.00
New York	30.66	35.20	36.45	55.38	38.94	49.84	50.22	49.00	51.45	55.86
New Jersey	45.75	42.33	41.40	50.15	80.52	68.31	70.15	69.75	79.20	88.80
Pennsylvania	31.32	36.55	30.74	47.12	47.31	56.42	57.24	58.50	53.58	58.96
Delaware	33.81	26.52	28.80	42.90	40.29	47.04	44.52	54.87	57.23	64.38
Maryland	30.74	32.64	29.70	46.20	41.60	42.00	50.49	55.10	52.08	57.00
Virginia	37.40	36.96	34.22	52.54	43.50	53.76	45.65	47.04	50.25	54.39
West Virginia	33.48	37.44	40.80	44.20	48.96	52.80	54.54	51.04	59.17	66.41
North Carolina	41.54	37.62	39.65	46.08	42.88	49.58	54.60	52.36	55.50	68.65
South Carolina	65.00	58.24	78.00	77.00	66.24	84.24	88.88	85.49	86.10	77.00
Georgia	40.50	38.18	52.36	67.84	52.20	68.62	74.90	72.80	84.70	83.00
Florida	76.80	85.56	63.60	79.98	109.80	103.32	131.58	90.00	93.50	76.00
Ohio	25.01	30.53	30.40	45.90	41.36	50.63	46.06	49.14	52.80	51.68
Indiana	29.11	32.68	31.54	27.90	41.41	50.16	41.85	46.40	50.73	56.55
Illinois	32.20	39.36	37.72	32.55	49.56	51.84	50.76	50.25	60.14	62.64
Michigan	21.33	21.12	25.22	55.08	29.52	38.22	35.09	37.52	32.30	40.50
Wisconsin	23.52	26.78	28.84	50.25	37.95	33.64	35.28	42.16	29.10	40.95
Minnesota	21.25	24.00	24.30	45.56	30.38	39.04	29.58	41.00	34.04	41.41
Iowa	24.00	23.00	26.64	30.08	33.32	42.00	38.08	39.20	40.85	46.75
Missouri	29.04	33.20	32.55	18.02	44.80	50.16	46.08	45.10	47.88	59.03
North Dakota	29.58	27.81	25.48	53.90	34.65	40.32	35.52	36.10	45.08	55.19
South Dakota	20.16	21.06	26.28	38.25	32.56	48.06	28.80	36.48	35.00	42.00
Nebraska	24.05	23.50	32.34	34.65	36.99	41.60	31.20	34.41	45.24	51.10
Kansas	35.70	42.75	34.56	27.04	62.10	49.30	44.80	55.89	55.30	57.20
Kentucky	29.44	31.11	35.00	30.45	42.40	49.64	45.65	45.05	50.02	60.00
Tennessee	29.64	28.60	31.32	39.56	39.68	42.24	44.02	46.40	49.60	64.59
Alabama	61.42	48.72	56.58	73.03	46.50	64.32	60.39	70.40	69.75	95.00
Mississippi	53.28	62.22	54.78	71.30	63.48	72.16	69.70	93.50	73.95	83.67
Louisiana	58.50	48.60	55.30	60.60	53.30	45.50	63.70	58.24	46.50	60.33
Texas	67.08	58.24	54.56	67.50	56.10	58.96	66.96	59.52	66.99	76.64
Indian Territory	......	......	......	78.12	54.40	60.20	51.75	62.32	57.00	70.00
Oklahoma	......	......	......	69.30	74.69	76.44	65.45	67.76	68.00	
Arkansas	40.70	44.73	41.04	57.96	48.96	55.30	57.75	47.45	53.60	63.68
Montana	57.20	74.73	71.02	114.61	76.50	77.44	87.23	70.80	92.72	75.00
Wyoming	78.00	76.25	67.32	112.40	65.27	95.19	99.82	95.20	74.75	148.00
Colorado	41.58	46.20	45.92	108.00	51.00	87.00	58.83	91.20	56.25	99.00
New Mexico	45.24	33.32	21.66	59.00	58.32	73.08	48.36	66.75	108.90	96.00
Utah	41.85	66.00	56.64	68.40	70.65	83.19	65.76	56.76	82.50	65.00
Nevada	139.50	91.80	87.36	128.31	133.56	81.90	85.15	98.40	122.50	180.00
Idaho	64.80	75.64	63.92	90.72	55.13	73.60	87.57	67.20	71.75	75.43
Washington	42.14	72.00	54.52	71.37	51.68	52.20	67.20	65.32	72.24	75.00
Oregon	40.42	56.35	49.50	63.00	56.65	53.50	51.33	66.00	56.56	70.00
California	52.25	74.97	55.12	77.77	68.44	85.80	86.43	110.55	92.50	130.50
General average	31.11	34.60	34.78	50.27	45.22	51.99	49.96	53.67	52.29	58.86

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Average farm price of potatoes per bushel in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	46	42	49	67	65	56	48	61	50	56
New Hampshire	49	46	53	79	69	65	56	72	60	67
Vermont	42	36	40	64	58	50	47	71	55	53
Massachusetts	63	57	66	90	81	71	71	84	65	84
Rhode Island	64	50	70	93	75	82	76	89	80	93
Connecticut	55	46	70	94	73	78	72	91	72	77
New York	42	40	45	71	59	56	54	70	49	57
New Jersey	61	51	60	85	61	69	61	75	66	74
Pennsylvania	58	43	53	76	57	62	54	65	57	67
Delaware	69	51	60	78	51	56	53	59	59	65
Maryland	53	51	54	77	52	60	51	58	56	60
Virginia	55	56	59	74	58	64	55	56	67	68
West Virginia	54	52	51	85	51	66	54	58	61	80
North Carolina	62	66	65	72	67	74	70	68	74	78
South Carolina	100	104	100	110	96	104	101	103	105	110
Georgia	75	83	77	106	90	94	107	112	110	100
Florida	120	124	106	129	122	126	129	120	110	*a* 95
Ohio	41	43	40	85	44	61	47	63	48	68
Indiana	41	43	38	90	41	66	45	58	57	65
Illinois	46	41	41	93	42	72	47	67	62	72
Michigan	27	32	26	68	41	49	29	56	34	45
Wisconsin	24	26	28	67	33	58	28	62	30	45
Minnesota	25	25	30	67	31	61	29	50	37	41
Iowa	30	23	37	94	34	75	28	49	43	55
Missouri	44	40	35	106	35	76	48	55	57	72
North Dakota	34	27	49	49	33	48	32	38	46	62
South Dakota	28	27	36	85	44	54	30	38	35	50
Nebraska	37	25	49	105	27	65	26	37	52	70
Kansas	51	45	48	104	45	85	56	69	70	88
Kentucky	46	61	50	87	53	68	55	53	61	75
Tennessee	57	65	58	86	64	64	62	58	62	76
Alabama	83	87	82	109	93	96	99	88	93	100
Mississippi	72	102	83	115	92	88	85	85	87	93
Louisiana	75	81	79	101	82	91	91	91	75	90
Texas	86	91	88	125	85	88	93	93	87	105
Indian Territory	......	......	......	124	64	86	75	82	75	100
Oklahoma	......	......	......	126	77	98	77	88	80	
Arkansas	55	71	57	126	68	79	75	73	67	91
Montana	55	53	53	73	50	44	61	59	61	50
Wyoming	65	61	68	100	61	57	62	56	65	74
Colorado	54	55	82	90	51	60	37	57	45	66
New Mexico	78	68	114	118	81	84	78	89	90	96
Utah	31	55	48	60	45	47	48	43	50	65
Nevada	90	90	56	91	63	70	65	82	70	90
Idaho	54	61	47	84	37	46	63	48	41	52
Washington	39	50	47	61	38	36	56	46	56	50
Oregon	47	49	45	70	55	50	59	60	56	56
California	55	63	53	77	58	66	67	67	74	90
General average	41.4	39.0	43.1	76.7	47.1	61.4	45.3	61.7	51.1	61.7

a Estimated.

Wholesale prices of potatoes per bushel, 1903–1907.

Date.	Chicago.		Milwaukee.		St. Louis.		Cincinnati.	
	Burbank, per bushel.		Per bushel.		Burbank, per bushel.		Per barrel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	45	48	40	45	50	55	$1.65	$1.80
February	45	47	38	40	51	54	1.50	1.60
March	43	47	35	40	50	53	1.50	1.70
April	38	46	35	40	42	54	1.35	1.65
May	42	60	35	52	45	63	1.65	1.90
June	50	85	46	90	65	125	1.50	3.00
July	......	......	35	75	40	65	1.75	2.25
August	......	......	40	70	......	......	1.75	1.95
September	......	......	35	60	......	......	1.50	1.80
October	54	60	45	60	55	72	1.20	1.80
November	50	70	50	65	67	80	1.20	2.10
December	60	66	55	65	65	68	1.80	2.10
1904.								
January	62	95	50	85	69	73	1.95	2.55
February	85	91	78	85	90	96	2.70	2.85
March	86	102	83	95	94	97	2.80	4.50
April	89	122	90	120	115	125	3.75	4.80
May	95	116	75	118	105	115	3.30	4.80
June	115	118	75	120	......	......	2.70	4.50
July	......	......	40	90	......	......	2.00	3.00
August	......	......	30	60	......	......	1.50	1.80
September	......	......	28	78	47	52	1.35	1.65
October	31	40	25	33	42	45	1.20	1.50
November	32	42	20	30	36	43	1.20	1.50
December	32	38	20	30	36½	45	1.20	1.35
1905.							Per bushel.	
January	32	38	22	32	35	42	.38	.42
February	33	37	22	32	40	50	.35	.43
March	25	37	20	30	31	38	.25	.40
April	20	29	18	25	27	40	.25	.32
May	20	25	15	26	65	175	.25	.30
June	18	25	10	21	35	70	.25	.60
July	......	......	10	52	35	45	.45	.55
August	......	......	35	55	30	48	.45	.50
September	43	48	35	50	40	60	.45	.55
October	43	72	38	65	52	73	.50	.75
November	64	70	50	70	62	80	.60	.75
December	55	66	40	62	58	66	.55	.80
1906.								
January	55	66	45	58	58	82	.55	.65
February	47	57	35	50	53	61	.45	.62
March	43	68	35	62	51	70	.45	.75
April	57	63	50	62	65	68	.60	.85
May	48	73	45	75	60	88	.55	.75
June	60	87	50	80	65	125	.90	1.05
July	......	......	40	87	35	75	.75	.90
August	......	......	35	50	37	60	.58	.80
September	45	58	35	55	43	62	.55	.60
October	40	47	25	40	48	56	.50	.60
November	41	48	25	40	45	55	.45	.58
December	40	[a] 43	25	40	40	46	.45	.47
1907.								
January	34	45	25	45	43	53	.45	.50
February	37	48	25	45	51	56	.48	.53
March	33	47	25	45	43	55	.50	.53
April	33	61	25	60	63	68	.40	.80
May	55	75	40	70	74	75	.70	.80
June	32	70	30	70	60	78	.60	.70
July	30	50	35	90	50	125	.25	.85
August	......	......	30	90	60	95	.70	.80
September	50	60	45	75	45	72	.60	.85
October	45	65	40	75	55	70	.50	.62
November	45	63	40	65	53	65	.50	.65
December	46	58	40	65	55	64	.50	.65

[a] Common to fancy.

HAY.

Acreage, production, value, prices, and exports of hay in the United States, 1850–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per ton Dec. 1	Farm value Dec. 1.	Chicago prices No. 1 timothy per ton, by carload lots. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal year beginning July 1.
	Acres.	*Tons.*	*Tons.*[a]	*Dolls.*	*Dollars.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Tons.*
1850[b]	....	....	13,838,642	....	....	....	....	....	....	....
1860[b]	....	....	19,083,896	....	....	....	....	....	....	....
1866	17,668,904	1.23	21,778,627	10.14	220,835,771	....	....	....	....	5,028
1867	20,020,554	1.31	26,277,000	10.21	268,300,623	....	....	....	....	5,645
1868	21,541,573	1.21	26,141,900	10.08	263,589,235	....	....	....	....	....
1869	18,591,281	1.42	26,420,000	10.18	268,933,048	....	....	....	....	6,723
1870	19,861,805	1.23	24,525,000	12.47	305,743,224	....	....	....	....	4,581
1871	19,099,052	1.17	22,239,400	14.30	317,939,799	....	....	....	....	5,266
1872	20,318,936	1.17	23,812,800	12.94	308,024,517	....	....	....	....	4,557
1873	21,894,084	1.15	25,085,100	12.53	314,241,037	....	....	....	....	4,889
1874	21,769,772	1.15	25,133,900	11.94	300,222,454	....	....	....	....	7,183
1875	23,507,964	1.19	27,873,600	10.78	300,377,839	....	....	....	....	7,528
1876	25,282,797	1.22	30,867,100	8.97	276,991,422	....	....	9.00	10.00	7,287
1877	25,367,708	1.25	31,629,300	8.37	264,879,796	9.50	10.50	9.75	10.75	9,514
1878	26,931,300	1.47	39,608,296	7.20	285,015,625	8.00	8.50	9.00	11.50	8,127
1879	27,484,991	1.29	35,493,000	9.32	330,804,494	14.00	14.50	14.00	15.00	13,739
1880	25,863,955	1.23	31,925,233	11.65	371,811,084	15.00	15.50	17.00	19.00	12,662
1881	30,888,700	1.14	35,135,064	11.82	415,131,366	16.00	16.50	15.00	16.50	10,570
1882	32,339,585	1.18	38,138,049	9.70	371,170,326	11.50	12.25	12.00	13.00	13,309
1883	35,515,948	1.32	46,864,009	8.19	383,834,451	9.00	10.00	12.50	17.00	16,908
1884	38,571,593	1.26	48,470,460	8.17	396,139,309	10.00	11.50	15.50	17.50	11,142
1885	39,849,701	1.12	44,731,550	8.71	389,752,873	11.00	12.00	10.00	12.00	13,390
1886	36,501,688	1.15	41,796,499	8.46	353,437,699	9.50	10.50	11.00	12.50	13,873
1887	37,664,739	1.10	41,454,458	9.97	413,440,283	13.50	14.50	17.00	21.00	18,198
1888	38,591,903	1.21	46,643,094	8.76	408,499,565	11.00	11.50	10.50	11.00	21,928
1889	52,947,236	1.26	66,829,612	7.04	470,374,948	9.00	10.00	9.00	14.00	36,274
1890	50,712,513	1.19	60,197,589	7.87	473,569,972	9.00	10.50	12.50	15.50	28,066
1891	51,044,490	1.19	60,817,771	8.12	494,113,616	12.50	15.00	13.50	14.00	35,201
1892	50,853,061	1.18	59,823,735	8.20	490,427,798	11.00	11.50	12.00	13.50	33,084
1893	49,613,469	1.33	65,766,158	8.68	570,882,872	10.00	10.50	10.00	10.50	54,446
1894	48,321,272	1.14	54,874,408	8.54	468,578,321	10.00	11.00	10.00	10.25	47,117
1895	44,206,453	1.06	47,078,541	8.35	393,185,615	12.00	12.50	11.50	12.00	59,052
1896	43,259,756	1.37	59,282,158	6.55	388,145,614	8.00	8.50	8.50	9.00	61,658
1897	42,426,770	1.43	60,664,876	6.62	401,390,728	8.00	8.50	9.50	10.50	81,827
1898	42,780,827	1.55	66,376,920	6.00	398,060,647	8.00	8.25	9.50	10.50	64,916
1899	41,328,462	1.35	56,655,756	7.27	411,926,187	10.50	11.50	10.50	12.50	72,716
1900	39,132,890	1.28	50,110,906	8.89	445,538,870	11.50	14.00	12.50	13.50	89,364
1901	39,390,508	1.28	50,590,877	10.01	506,191,533	13.00	13.50	12.50	13.50	153,431
1902	39,825,227	1.50	59,857,576	9.06	542,036,364	12.00	12.50	13.50	15.00	50,970
1903	39,933,759	1.54	61,305,940	9.08	556,376,880	10.00	12.00	12.00	15.00	60,730
1904	39,998,602	1.52	60,696,028	8.72	529,107,625	10.50	11.50	11.00	12.00	66,557
1905	39,361,960	1.54	60,531,611	8.52	515,959,784	10.00	12.00	11.50	12.50	70,172
1906	42,476,224	1.35	57,145,959	10.37	592,539,671	15.50	18.00	15.50	20.50	58,602
1907	44,028,000	1.45	63,677,000	11.68	743,507,000	13.00	17.50	13.00	15.00	....

[a] 2,000 pounds. [b] Census figures.

Acreage, production, and value of hay in the United States in 1907, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Tons.a*	*Tons.a*	*Dollars.*	*Dollars.*
Maine	1,400,000	1.50	2,100,000	12.50	26,250,000
New Hampshire	640,000	1.35	864,000	15.75	13,608,000
Vermont	885,000	1.60	1,416,000	12.75	18,054,000
Massachusetts	585,000	1.30	760,000	19.00	14,440,000
Rhode Island	60,000	1.35	81,000	19.00	1,539,000
Connecticut	490,000	1.30	637,000	17.00	10,829,000
New York	4,717,000	1.25	5,896,000	15.50	91,388,000
New Jersey	437,000	1.45	634,000	17.00	10,778,000
Pennsylvania	3,150,000	1.45	4,568,000	15.75	71,946,000
Delaware	78,000	1.40	109,000	17.50	1,907,000
Maryland	283,000	1.40	396,000	16.00	6,336,000
Virginia	432,000	1.40	605,000	15.75	9,529,000
West Virginia	600,000	1.45	870,000	15.50	13,485,000
North Carolina	127,000	1.50	190,000	16.50	3,135,000
South Carolina	61,000	1.50	92,000	16.50	1,518,000
Georgia	95,000	1.75	166,000	18.00	2,988,000
Florida	20,000	1.35	27,000	19.00	513,000
Ohio	2,793,000	1.45	4,050,000	11.75	47,588,000
Indiana	2,328,000	1.35	3,143,000	12.00	37,716,000
Illinois	2,664,000	1.40	3,730,000	11.00	41,030,000
Michigan	2,597,000	1.25	3,246,000	12.50	40,575,000
Wisconsin	2,300,000	1.35	3,105,000	11.50	35,708,000
Minnesota	900,000	1.70	1,530,000	7.50	11,475,000
Iowa	3,500,000	1.40	4,900,000	8.00	39,200,000
Missouri	2,900,000	1.40	4,060,000	9.25	37,555,000
North Dakota	183,000	1.30	238,000	6.50	1,547,000
South Dakota	500,000	1.40	700,000	5.50	3,850,000
Nebraska	1,500,000	1.50	2,250,000	6.25	14,062,000
Kansas	1,793,000	1.15	2,062,000	7.25	14,950,000
Kentucky	443,000	1.35	598,000	13.50	8,073,000
Tennessee	339,000	1.50	508,000	15.00	7,620,000
Alabama	110,000	1.80	198,000	15.25	3,019,000
Mississippi	80,000	1.60	128,000	13.00	1,664,000
Louisiana	22,000	2.00	44,000	15.00	660,000
Texas	380,000	1.30	494,000	10.75	5,310,000
Oklahoma	392,000	1.20	470,000	6.50	3,055,000
Arkansas	200,000	1.25	250,000	11.75	2,937,000
Montana	500,000	1.70	850,000	9.50	8,075,000
Wyoming	250,000	2.10	525,000	7.50	3,938,000
Colorado	677,000	2.70	1,828,000	9.50	17,366,000
New Mexico	160,000	2.05	328,000	11.75	3,854,000
Arizona	90,000	2.90	261,000	14.00	3,654,000
Utah	355,000	2.10	746,000	7.00	5,222,000
Nevada	182,000	1.75	318,000	10.00	3,180,000
Idaho	421,000	2.40	1,010,000	8.50	8,585,000
Washington	366,000	2.10	769,000	15.00	11,535,000
Oregon	406,000	2.00	812,000	10.25	8,323,000
California	637,000	1.75	1,115,000	12.50	13,938,000
United States	44,028,000	1.45	63,677,000	11.68	743,507,000

a 2,000 pounds.

Average yield[a] per acre of hay in the United States, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Maine	1.20	0.90	0.90	1.05	1.07	0.98	1.10	1.08	1.20	1.50
New Hampshire	1.25	.89	.87	1.28	1.06	.92	1.02	1.16	1.15	1.35
Vermont	1.45	1.14	1.24	1.36	1.27	1.18	1.25	1.35	1.20	1.60
Massachusetts	1.42	1.13	.97	1.21	1.60	1.36	1.23	1.33	1.31	1.30
Rhode Island	1.18	.89	.92	.92	1.03	1.07	1.16	1.09	1.06	1.35
Connecticut	1.31	.94	.89	1.01	1.35	1.11	1.06	1.12	1.17	1.30
New York	1.40	1.04	.81	1.30	1.34	1.26	1.36	1.30	1.28	1.25
New Jersey	1.42	.83	1.26	1.32	1.22	1.28	1.39	1.13	1.32	1.45
Pennsylvania	1.45	1.20	1.10	1.19	1.19	1.27	1.45	1.50	1.30	1.45
Delaware	1.38	1.04	.98	1.12	1.09	1.64	1.59	1.55	1.25	1.40
Maryland	1.20	1.13	1.09	1.22	1.01	1.24	1.36	1.30	1.26	1.40
Virginia	1.32	1.10	1.16	1.20	1.06	1.30	1.39	1.30	1.25	1.40
West Virginia	1.54	1.29	1.18	1.37	1.12	1.38	1.47	1.48	1.40	1.45
North Carolina	1.70	1.50	1.41	1.66	1.44	1.60	1.72	1.60	1.54	1.50
South Carolina	1.60	1.22	1.32	1.46	1.22	1.46	1.53	1.42	1.46	1.50
Georgia	1.75	1.45	1.69	1.46	1.36	1.53	1.52	1.50	1.65	1.75
Florida	1.60	1.46	1.20	1.48	1.24	1.47	1.36	1.48	1.50	1.35
Ohio	1.39	1.30	1.06	1.36	1.43	1.42	1.43	1.49	1.22	1.45
Indiana	1.45	1.34	1.21	1.27	1.46	1.47	1.37	1.48	1.10	1.35
Illinois	1.56	1.29	1.27	1.08	1.50	1.54	1.36	1.35	.98	1.40
Michigan	1.36	1.22	1.29	1.26	1.45	1.37	1.25	1.46	1.28	1.25
Wisconsin	1.50	1.47	1.15	1.29	1.90	1.89	1.67	1.80	1.35	1.35
Minnesota	1.80	1.70	1.16	1.55	1.76	1.84	1.74	1.75	1.70	1.70
Iowa	1.75	1.34	1.42	1.25	1.68	1.78	1.62	1.70	1.35	1.40
Missouri	1.60	1.37	1.29	.75	1.59	1.57	1.47	1.10	.78	1.40
North Dakota	1.50	1.58	.92	1.60	1.66	1.18	1.57	1.55	1.45	1.30
South Dakota	1.38	1.43	1.18	1.15	1.23	1.45	1.43	1.60	1.50	1.40
Nebraska	1.60	1.66	1.38	1.25	1.74	1.68	1.76	1.75	1.40	1.50
Kansas	1.46	1.57	1.32	.91	1.70	1.58	1.67	1.55	1.28	1.15
Kentucky	1.45	1.29	1.40	1.34	1.44	1.46	1.44	1.30	1.35	1.35
Tennessee	1.50	1.31	1.40	1.52	1.44	1.58	1.66	1.60	1.51	1.50
Alabama	1.90	1.66	1.85	1.75	1.50	1.77	1.71	1.90	1.95	1.80
Mississippi	1.90	1.44	1.75	1.69	1.40	1.74	1.72	1.75	1.90	1.60
Louisiana	2.10	1.95	2.00	1.85	1.80	2.04	2.06	2.30	1.93	2.00
Texas	1.50	1.43	1.80	1.25	1.40	1.84	1.77	1.90	1.80	1.30
Indian Territory	......	......	......	1.46	1.32	1.50	1.49	1.27	1.40	1.20
Oklahoma	......	......	......	.96	1.26	1.34	1.51	1.43	1.40	
Arkansas	1.54	1.48	1.63	1.10	1.60	1.60	1.72	1.75	1.60	1.25
Montana	1.45	1.42	1.60	1.79	1.68	2.08	1.92	1.60	1.85	1.70
Wyoming	1.96	1.47	1.68	1.76	1.65	2.14	2.27	2.50	2.25	2.10
Colorado	2.20	2.10	2.23	2.08	1.92	2.56	1.85	2.65	2.50	2.70
New Mexico	3.75	1.70	2.06	2.31	2.40	2.36	2.58	2.70	2.50	2.05
Arizona	3.50	2.63	2.31	2.85	2.34	3.46	2.71	3.75	3.50	2.90
Utah	3.25	2.50	2.65	2.45	2.62	2.95	3.54	3.25	4.00	2.10
Nevada	2.60	1.87	2.43	2.50	2.91	3.12	3.04	2.50	1.50	1.75
Idaho	3.75	2.50	2.80	2.58	2.67	2.82	3.07	3.10	2.95	2.40
Washington	1.75	2.02	2.16	2.30	2.29	2.41	2.18	2.65	2.38	2.10
Oregon	1.90	1.97	2.35	2.07	2.04	2.07	2.04	2.30	2.18	2.00
California	1.60	1.63	1.51	1.82	1.81	2.08	2.03	2.40	1.85	1.75
General average	1.55	1.35	1.28	1.28	1.50	1.54	1.52	1.54	1.35	1.45

a In tons of 2,000 pounds.

Average farm value per acre of hay in the United States December 1, 1898–1907, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$9.12	$9.09	$11.66	$10.96	$10.74	$10.00	$10.69	$10.69	$12.30	$18.75
New Hampshire	11.56	10.46	13.48	15.87	14.36	12.20	13.76	15.08	14.38	21.26
Vermont	9.21	10.55	13.70	13.36	12.26	12.84	11.85	12.73	12.00	20.40
Massachusetts	17.18	17.52	16.88	21.16	26.64	22.74	19.38	20.24	22.27	24.68
Rhode Island	14.93	15.35	17.20	17.54	19.46	20.28	20.16	17.73	18.44	25.65
Connecticut	14.61	13.63	14.89	14.77	21.19	16.86	15.78	16.35	17.55	22.10
New York	8.05	10.87	11.38	13.75	14.11	13.81	14.20	13.49	15.49	19.37
New Jersey	13.63	12.74	20.22	18.86	19.08	19.70	20.39	16.74	21.05	24.66
Pennsylvania	11.46	13.80	15.29	15.90	16.66	17.15	17.14	17.90	17.42	22.84
Delaware	11.66	12.12	13.67	13.84	15.73	24.32	22.09	21.19	18.75	24.45
Maryland	11.16	13.73	15.31	16.07	14.19	17.38	16.97	15.50	17.01	22.39
Virginia	11.22	11.27	15.43	14.41	14.39	17.85	17.44	16.41	19.37	22.06
West Virginia	12.94	12.19	15.81	18.91	16.05	19.04	18.24	17.24	19.60	22.48
North Carolina	15.81	15.15	15.79	17.93	17.64	21.47	25.04	20.48	23.10	24.69
South Carolina	15.20	12.56	15.18	16.03	13.72	17.11	18.64	18.97	22.27	24.89
Georgia	20.56	19.07	21.55	20.92	18.22	23.18	23.01	23.63	25.99	31.45
Florida	22.56	22.41	16.44	22.72	19.02	27.67	22.67	24.05	22.50	25.64
Ohio	7.99	11.63	11.71	11.86	14.59	14.20	13.23	11.92	14.64	17.05
Indiana	8.12	10.45	11.80	11.79	12.66	12.58	11.75	11.16	13.75	16.20
Illinois	9.20	10.00	10.67	12.10	13.31	12.83	11.78	11.16	12.25	15.40
Michigan	9.72	10.37	12.19	10.85	12.03	12.23	11.36	11.24	13.25	15.62
Wisconsin	8.62	10.07	11.10	13.58	15.03	14.17	13.18	13.05	12.15	15.53
Minnesota	6.66	7.40	8.06	8.65	9.43	12.16	9.59	10.15	9.35	12.75
Iowa	7.09	7.10	9.66	9.59	10.92	9.72	8.68	8.67	9.45	11.20
Missouri	9.28	8.56	8.97	8.99	10.96	10.49	9.73	8.62	7.80	12.95
North Dakota	4.87	5.21	5.20	5.84	6.09	5.48	6.61	6.71	6.52	8.45
South Dakota	4.14	4.43	4.66	5.16	5.10	6.71	6.06	6.43	6.75	7.70
Nebraska	5.28	6.14	7.11	7.71	7.59	7.53	6.72	7.24	7.84	9.37
Kansas	4.74	5.49	6.01	7.25	7.33	7.60	7.31	7.87	8.00	8.34
Kentucky	13.19	13.42	15.89	16.25	16.27	17.62	16.57	13.82	17.89	18.22
Tennessee	14.25	14.74	16.52	18.71	16.99	19.42	19.94	18.43	20.31	22.48
Alabama	17.57	18.92	19.52	21.12	17.42	21.93	20.74	23.79	25.93	27.45
Mississippi	15.96	13.32	17.41	17.62	14.35	20.18	18.66	19.55	21.76	20.80
Louisiana	19.74	18.92	18.80	20.50	21.10	23.15	25.13	26.45	22.20	30.00
Texas	8.77	10.15	12.24	13.27	12.04	15.09	14.37	15.43	15.30	13.97
Indian Territory	....	....	....	11.01	6.57	8.86	6.88	6.79	7.70	7.79
Oklahoma	....	....	....	6.59	6.68	7.52	7.40	7.03	8.05	
Arkansas	10.39	12.80	14.43	12.89	15.04	15.17	16.89	16.80	15.84	14.68
Montana	9.86	10.93	13.92	14.60	12.67	18.32	16.70	12.32	16.46	16.15
Wyoming	11.40	9.70	12.26	12.64	12.01	14.27	13.05	15.52	17.44	15.75
Colorado	11.88	15.43	16.95	18.80	18.99	19.15	12.41	21.73	23.75	25.65
New Mexico	27.56	18.02	20.39	23.89	26.83	26.24	29.46	29.03	26.88	24.09
Arizona	42.00	27.22	26.10	26.16	28.62	35.78	40.22	46.39	42.00	40.60
Utah	14.62	17.75	21.07	20.70	19.18	20.18	22.34	21.68	30.00	14.71
Nevada	18.20	14.31	18.71	19.80	29.73	31.11	23.10	21.25	12.00	17.47
Idaho	18.37	15.75	18.20	15.25	14.69	19.64	18.67	18.29	23.60	20.39
Washington	13.30	17.98	20.52	19.60	20.45	30.78	24.72	25.63	26.18	31.52
Oregon	13.78	13.49	15.98	14.82	15.26	21.07	20.77	17.80	17.11	20.50
California	22.80	13.04	12.31	14.41	17.03	24.25	21.13	24.12	20.81	21.88
General average	9.30	9.97	11.39	12.85	13.61	13.93	13.23	13.11	13.95	16.89

Average farm price of hay per ton in the United States December 1, 1898–1907, by States.

State or Territory	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Maine	$7.60	$10.10	$12.95	$10.44	$10.04	$10.20	$9.72	$9.90	$10.25	$12.50
New Hampshire	9.25	11.75	15.50	12.40	13.55	13.26	13.49	13.00	12.50	15.75
Vermont	6.35	9.25	11.05	9.82	9.65	10.88	9.48	9.43	10.00	12.75
Massachusetts	12.10	15.50	17.40	17.49	16.65	16.72	15.76	15.22	17.00	19.00
Rhode Island	12.65	17.25	18.70	19.06	18.89	18.95	17.38	16.27	17.40	19.00
Connecticut	11.15	14.50	16.73	14.62	15.70	15.19	14.89	14.60	15.00	17.00
New York	5.75	10.45	14.05	10.58	10.53	10.96	10.44	10.38	12.10	15.50
New Jersey	9.60	15.35	16.05	14.29	15.64	15.39	14.67	14.81	15.95	17.00
Pennsylvania	7.90	11.50	13.90	13.64	14.00	13.50	11.82	11.93	13.40	15.75
Delaware	8.45	11.65	13.95	12.36	14.43	14.83	13.89	13.67	15.00	17.50
Maryland	9.30	12.15	14.05	13.17	14.05	14.02	12.48	11.92	13.50	16.00
Virginia	8.50	10.25	13.30	12.01	13.58	13.73	12.55	12.62	15.50	15.75
West Virginia	8.40	9.45	13.40	13.80	14.33	13.80	12.41	11.65	14.00	15.50
North Carolina	9.30	10.10	11.20	10.80	12.25	13.42	14.56	12.80	15.00	16.50
South Carolina	9.50	10.30	11.50	10.98	11.25	11.72	12.18	13.36	15.25	16.50
Georgia	11.75	13.15	12.75	14.33	13.40	15.15	15.14	15.75	15.75	18.00
Florida	14.10	15.35	13.70	15.35	15.34	18.82	16.67	16.25	15.00	19.00
Ohio	5.75	8.95	11.05	8.72	10.20	10.00	9.25	8.00	12.00	11.75
Indiana	5.60	7.80	9.75	9.28	8.67	8.56	8.58	7.54	12.50	12.00
Illinois	5.90	7.75	8.40	11.20	8.87	8.33	8.66	8.27	12.50	11.00
Michigan	7.15	8.50	9.45	8.61	8.30	8.93	9.09	7.70	10.35	12.50
Wisconsin	5.75	6.85	9.65	10.53	7.91	7.50	7.89	7.25	9.00	11.50
Minnesota	3.70	4.35	6.95	5.58	5.36	6.61	5.51	5.80	5.50	7.50
Iowa	4.05	5.30	6.80	7.67	6.50	5.46	5.36	5.10	7.00	8.00
Missouri	5.80	6.25	6.95	11.99	6.89	6.68	6.62	7.84	10.00	9.25
North Dakota	3.25	3.30	5.65	3.65	3.67	4.64	4.21	4.33	4.50	6.50
South Dakota	3.00	3.10	3.95	4.49	4.15	4.63	4.24	4.02	4.50	5.50
Nebraska	3.30	3.70	5.15	6.17	4.36	4.48	3.82	4.14	5.60	6.25
Kansas	3.25	3.50	4.55	7.97	4.31	4.81	4.38	5.08	6.25	7.25
Kentucky	9.10	10.40	11.35	12.13	11.30	12.07	11.51	10.63	13.25	13.50
Tennessee	9.50	11.25	11.80	12.31	11.80	12.29	12.01	11.52	13.45	15.00
Alabama	9.25	11.40	10.55	12.07	11.61	12.39	12.13	12.52	13.30	15.25
Mississippi	8.40	9.25	9.95	10.51	10.25	11.60	10.85	11.17	11.45	13.00
Louisiana	9.40	9.70	9.40	11.08	11.72	11.35	12.20	11.50	11.50	15.00
Texas	5.85	7.10	6.80	10.62	8.60	8.20	8.12	8.12	8.50	10.75
Indian Territory	......	......	......	7.54	4.98	5.91	4.62	5.35	5.50	6.50
Oklahoma	......	......	......	6.86	5.30	5.61	4.90	4.91	5.75	
Arkansas	6.75	8.65	8.85	11.72	9.40	9.48	9.82	9.60	9.90	11.75
Montana	6.80	7.70	8.70	8.18	7.54	8.81	8.70	7.70	8.90	9.50
Wyoming	5.90	6.60	7.30	7.18	7.28	6.67	5.75	6.21	7.75	7.50
Colorado	5.40	7.35	7.60	9.04	9.89	7.48	6.71	8.20	9.50	9.50
New Mexico	7.35	10.60	9.90	10.34	11.18	11.12	11.42	10.75	10.75	11.75
Arizona	12.00	10.35	11.30	9.18	12.23	10.34	14.84	12.37	12.00	14.00
Utah	4.50	7.10	7.95	8.45	7.32	6.84	6.31	6.67	7.50	7.00
Nevada	7.00	7.65	7.70	7.92	9.05	9.97	7.60	8.50	8.00	10.00
Idaho	4.90	6.30	6.50	5.91	5.50	6.86	6.08	5.90	8.00	8.50
Washington	7.60	8.90	9.50	8.52	8.93	12.77	11.34	9.67	11.00	15.00
Oregon	7.25	6.85	6.80	7.16	7.48	10.18	10.18	7.74	7.85	10.25
California	14.25	8.00	8.15	7.92	9.41	11.66	10.41	10.05	11.25	12.50
General average	6.00	7.27	8.89	10.01	9.06	9.08	8.72	8.52	10.37	11.68

Wholesale prices of hay (baled) per ton, 1903–1907.

Date.	Chicago.		Cincinnati.		St. Louis.		New York.	
	No. 1 timothy.		No. 1 timothy.		No. 1 timothy.		No. 1 timothy.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
January	$12.00	$13.00	$15.50	$17.25	$13.50	$15.50	$18.00	$21.00
February	12.00	13.00	16.00	16.75	13.50	15.00	18.50	21.00
March	12.00	13.50	16.00	17.50	14.00	16.00	18.00	20.00
April	13.00	15.00	16.25	18.00	13.50	16.00	18.50	23.00
May	13.50	15.00	15.25	18.00	13.00	16.00	19.00	23.00
June	13.00	15.00	17.50	19.50	14.50	25.00	20.00	26.00
July	13.00	13.50	16.50	18.00	9.50	16.50	20.00	23.00
August	11.00	13.50	11.50	17.00	10.00	15.00	18.00	20.00
September	10.00	12.00	11.50	13.50	10.00	12.00	16.00	18.50
October	10.00	11.50	12.50	13.25	10.00	12.50	16.00	18.00
November	10.00	11.50	12.25	12.75	10.00	12.50	17.00	18.00
December	10.00	12.00	12.50	13.00	10.00	13.50	16.00	18.00
1904.								
January	10.50	12.50	12.50	13.25	10.00	11.50	16.00	18.00
February	10.50	12.50	12.50	13.50	10.50	11.50	16.50	19.00
March	10.50	13.00	12.50	14.00	10.50	12.00	17.00	19.00
April	11.50	14.50	13.75	14.00	11.00	13.00	18.00	19.00
May	12.00	15.00	14.00	15.50	12.50	13.00	18.00	19.00
June	12.00	15.00	13.00	14.00	12.00	13.50	17.00	19.00
July	10.00	14.00	12.00	13.75	12.00	13.00	17.00	18.00
August	10.00	15.00	11.50	14.00	11.50	13.50	17.00	18.00
September	9.00	12.00	11.00	12.25	10.50	12.50	15.00	18.00
October	10.00	12.50	11.50	12.50	10.50	12.50	15.00	16.00
November	10.00	12.50	11.25	12.00	11.00	11.50	15.50	17.00
December	10.50	11.50	12.00	12.50	10.50	11.50	15.00	16.00
1905.								
January	10.50	12.00	12.00	12.75	11.00	12.75	15.50	17.00
February	11.00	12.00	11.75	12.25	10.50	12.50	15.50	16.00
March	11.00	12.00	11.75	13.00	10.50	12.50	15.00	17.50
April	11.00	12.00	12.00	12.50	11.00	13.00	15.00	16.00
May	11.00	12.00	11.50	12.50	10.50	13.00	15.00	16.00
June	10.00	12.00	10.25	11.75	10.50	12.50	15.00	16.00
July	10.00	12.00	10.50	12.50	10.00	14.00	14.00	15.00
August	11.00	12.50	10.00	12.50	9.00	13.50	15.00	19.00
September	10.00	12.50	11.50	12.50	10.00	13.00	14.50	16.00
October	10.00	11.50	12.25	12.50	10.50	13.50	15.00	16.00
November	11.00	12.00	12.00	13.50	12.00	15.00	15.00	16.50
December	10.00	12.00	12.25	13.50	12.50	15.50	14.00	15.00
1906.								
January	10.00	11.00	12.00	13.00	12.00	14.00	16.00	17.00
February	9.50	10.50	11.00	12.50	11.50	14.00	15.00	16.50
March	9.80	12.00	12.50	13.50	12.00	15.00	15.50	16.00
April	10.00	12.50	13.50	14.75	13.50	17.00	15.50	19.00
May	11.50	12.50	14.50	16.25	14.50	18.00	17.50	19.50
June	11.50	13.00	15.00	16.00	14.00	17.00	18.00	19.00
July	12.00	16.00	15.50	18.00	11.00	17.50	18.00	20.00
August	13.00	16.00	15.25	16.00	12.00	16.50	18.00	20.00
September	13.50	16.00	15.00	16.25	13.50	15.50	17.50	19.00
October	13.50	15.50	16.00	18.25	14.50	16.50	17.50	21.00
November	15.00	17.00	17.75	19.00	15.00	18.50	19.00	23.00
December	15.50	18.00	19.00	19.50	17.50	20.00	20.00	22.00
1907.							Per 100 pounds.	
January	14.50	16.50	18.00	19.50	17.00	19.00	1.05	1.10
February	15.00	17.00	18.00	19.00	16.50	19.00	1.05	1.10
March	15.00	17.00	18.50	19.50	16.75	19.00	1.10	1.20
April	15.00	18.00	19.00	20.50	16.50	18.50	1.10	1.20
May	15.50	20.50	19.75	22.75	17.00	20.50	1.15	1.25
June	18.50	21.50	20.00	22.00	18.00	21.50	1.15	1.25
July	17.50	19.00	17.00	21.75	18.00	21.00	1.10	1.20
August	18.00	19.50	14.00	18.50	15.00	24.00	1.15	1.20
September	15.00	19.50	14.50	17.50	15.00	22.00	1.00	1.20
October	14.50	19.00	16.00	17.75	14.00	19.50	1.00	1.15
November	14.50	17.00	14.50	16.75	14.50	18.25	1.05	1.10
December	13.00	17.50	15.00	16.50	14.00	18.00	1.00	1.10

COTTON.

Cotton crop of countries named, 1902–1906.

[No statistics for Siam and some other less important cotton-growing countries. Bales of 500 pounds, gross weight, or 478 pounds of lint, net.]

Country.	1902.	1903.	1904.	1905.	1906.
NORTH AMERICA.					
United States:	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Contiguous[a]	10,630,945	9,851,129	13,438,012	10,575,017	13,273,809
Noncontiguous — Porto Rico[b]	....	265	1,076	1,881	230
Total United States (except Philippine Islands).	10,630,945	9,851,394	13,439,088	10,576,898	13,274,039
Guatemala	[c] 147	147	[c] 147	[c] 147	[c] 147
Mexico	103,910	168,998	253,271	[d] 253,271	[d] 253,271
Nicaragua[b]	[e] 507	[e] 507	507	800	[f] 800
Salvador	[f] 2	[f] 2	[f] 2	2	[f] 2
West Indies:					
British—					
Bahamas[b]	3	13	18	14	27
Barbados	....	1	402	720	1,011
Grenada[b]	518	630	658	445	651
Jamaica[b]	....	6	30	184	40
Leeward Islands[b]	....	124	243	822	986
St. Lucia[b]	....	....	5	3	2
St. Vincent[b]	113	91	264	289	550
Trinidad and Tobago	....	....	33	[b] 31	23
Turks and Caicos Islands[b]	....	1	....	....	....
Cuba	....	77	[b] 61	[b] 21	[f] 21
French—					
Guadeloupe[b]	([g])	1	1	5	[f] 5
Martinique[b]	....	....	12	2	[f] 2
Haiti[b]	4,200	6,821	6,312	6,878	8,086
Total North America	10,740,345	10,028,813	13,701,054	10,840,532	13,539,663
SOUTH AMERICA.					
Argentina	[b] 17	[b] 26	[b] 142	[b] 495	[h] 10,000
Brazil[k]	305,000	285,000	220,000	270,000	365,000
British Guiana[b]	....	([g])	4	2	1
Chile[b]	860	1,182	634	1,335	[f] 1,335
Colombia and Venezuela[i]	5,000	5,000	5,000	5,000	5,000
Ecuador[b]	28	....	22	47	[f] 47
Peru	38,200	43,776	45,672	49,190	58,283
Paraguay[i]	200	200	200	200	200
Total South America	349,305	335,184	271,674	326,269	439,866
EUROPE.					
Bulgaria	[j] 765	[j] 765	[j] 765	765	[j] 765
Crete[i]	700	700	700	700	700
Greece[i]	8,200	8,200	8,200	8,200	8,200
Italy[i]	2,700	2,700	2,700	2,700	2,700
Malta	231	285	345	340	348
Turkey	[h] 8,000	[h] 7,000	[h] 6,000	[h] 7,000	[j] 7,000
Total Europe	20,596	19,650	18,710	19,705	19,713
ASIA.					
British India, including native States[k]	3,138,910	2,995,875	3,028,000	3,320,000	3,505,000
Ceylon[b]	428	317	371	324	559
China[i]	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Cyprus	817	692	1,118	1,637	3,361
Dutch East Indies[b]	8,267	12,632	15,367	13,280	15,944
Federated Malay States	....	3	1	[b] 1	....

[a] "Linters," a by-product obtained in the oil mills, not included. Quantity of linters produced as follows: Running bales, 166,026 in 1901, 196,223 in 1902; 500-pound bales, 194,486 in 1903, 241,942 in 1904, 229,539 in 1905, and 321,689 in 1906.
[b] Exports.
[c] Official estimate for 1903.
[d] Figures for 1904.
[e] Exports, 1904.
[f] Exports, 1905.
[g] Less than one-half bale.
[h] Unofficial estimate.
[i] Average production as unofficially estimated.
[j] Figures for 1905.
[k] Exports and mill consumption.

Cotton crop of countries named, 1902–1906—Continued.

Country.	1902.	1903.	1904.	1905.	1906.
ASIA—continued.	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*
French India [a]			[b] 14	14	[b] 14
French Indo-China [a]	11,139	13,693	15,255	18,103	[b] 18,103
Japan	19,152	17,012	16,262	12,370	9,239
Korea [c]	70,000	70,000	70,000	70,000	70,000
Persia [a]	[d] 64,000	56,282	71,509	81,931	[b] 81,931
Philippine Islands	6,098	[e] 6,098	[e] 6,098	[e] 6,098	[e] 6,098
Russia, Asiatic:					
Central Asia	370,000	476,000	506,000	567,000	494,798
Transcaucasia	[f] 56,000	[f] 53,000	[f] 49,000	[f] 45,000	58,929
Total Asiatic Russia	426,000	529,000	555,000	612,000	553,727
Turkey, Asiatic [c]	60,000	60,000	60,000	60,000	60,000
Total Asia	5,004,811	4,961,604	5,038,995	5,395,758	5,523,976
AFRICA.					
British Africa:					
Central Africa [a]	1	118	597	1,625	1,101
East Africa			609	208	167
Gambia [a]	([g])	3	125	5	([g])
Gold Coast [a]		22	121	61	194
Natal			3	[f] 31	42
Nigeria—					
Colony of Lagos [a]	26	606	1,805	2,675	5,640
Southern, Protectorate [a]			598	201	
Northern, Protectorate [a]			601	258	745
Sierra Leone [a]		2	59	144	184
Uganda [a]			45	201	819
Total British Africa	27	751	4,563	5,409	8,892
Egypt	1,209,746	1,348,759	1,316,212	1,234,984	1,440,107
French Africa: [a]					
Dahomey			289	[f] 84	[b] 84
Madagascar		([g])	8	11	[b] 11
Mayotte		1			([h])
Senegal		2	8	5	[b] 5
Somali Coast	([g])		41	106	[b] 106
Total French Africa		3	346	206	206
German Africa: [a]					
East Africa	2	43	872	871	844
Kamerun					2
Togo		148	499	618	892
Total German Africa	2	191	1,371	1,489	1,738
Italian Africa—Eritrea			43	62	[b] 62
Kongo Free State [a]				1	1
Portuguese Africa—					
Angola [i]	61	6	179	492	[b] 492
East Africa				26	[b] 26
Total Portuguese Africa	61	6	179	518	518
Sudan (Anglo-Egyptian)	[j] 6,517	6,517	15,097	19,441	17,782
Total Africa	1,216,353	1,356,227	1,337,811	1,262,110	1,469,306
OCEANIA.					
British—Queensland	1	1	18	79	54
French: [a]					
New Caledonia			1	([g])	([h])
Tahiti	79	71	48	39	[b] 39
German — Bismarck Archipelago [a]	13	240	56	15	[b] 15
Total Oceania	93	312	123	133	108
Grand total	17,331,503	16,701,790	20,368,367	17,844,517	20,992,632

[a] Exports.
[b] Figures for 1905.
[c] Average production as unofficially estimated.
[d] Average exports, 1903–1904.
[e] Census, 1902.
[f] Unofficial estimate.
[g] Less than one-half bale.
[h] No data.
[i] Imports from Angola into Portugal.
[j] Statistics for 1903.

Cotton acreage, by States, 1902–1907.

[As reported by Bureau of Statistics, Department of Agriculture.]

State or Territory.	1902.	1903.	1904.	1905.	1906.	1907.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Virginia	36,956	39,864	47,199	38,664	36,000	35,000
North Carolina	1,076,359	1,155,028	1,306,968	1,085,568	1,374,000	1,408,000
South Carolina	2,205,909	2,318,100	2,531,875	2,161,923	2,389,000	2,426,000
Georgia	3,862,439	4,048,912	4,227,188	3,738,703	4,610,000	4,774,000
Florida	253,288	268,666	267,372	256,173	283,000	265,000
Alabama	3,501,737	3,608,049	3,611,731	3,500,168	3,658,000	3,439,000
Mississippi	3,181,408	3,327,960	3,632,458	3,051,265	3,408,000	3,220,000
Louisiana	1,617,678	1,642,463	1,745,865	1,561,774	1,739,000	1,622,000
Texas	7,646,251	7,801,578	8,355,491	6,945,501	8,894,000	9,156,000
Arkansas	1,901,841	1,925,191	2,051,185	1,718,751	2,097,000	1,950,000
Tennessee	754,811	783,196	881,341	757,397	814,000	749,000
Missouri	59,786	66,496	79,403	66,444	91,000	71,000
Oklahoma	358,107	326,391	502,021	418,184	1,080,000	2,196,000
Indian Territory	657,533	702,966	813,642	816,638	901,000	
United States	27,114,103	28,014,860	30,053,739	26,117,153	31,374,000	31,311,000

Production of cotton, in 500-pound gross weight bales, by States, and total value of crop, 1902–1903 to 1907–1908.

[As finally reported by U. S. Census Bureau.]

State or Territory.	1902–3.	1903–4.	1904–5.	1905–6.	1906–7.	1907–8.
	Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Virginia	15,614	13,074	16,195	14,913	13,862	9,223
North Carolina	549,542	528,707	703,760	619,141	579,326	605,310
South Carolina	925,490	787,425	1,151,170	1,078,047	876,181	1,119,220
Georgia	1,425,044	1,267,364	1,887,853	1,682,555	1,592,572	1,815,834
Florida	58,960	52,386	79,171	68,797	55,945	49,794
Alabama	956,215	986,221	1,448,157	1,238,574	1,261,522	1,112,698
Mississippi	1,443,740	1,432,796	1,798,917	1,198,572	1,530,748	1,468,177
Louisiana	882,073	824,965	1,089,526	513,480	987,779	675,428
Texas	2,498,013	2,471,081	3,145,372	2,541,932	4,174,206	2,300,179
Arkansas	970,205	734,593	930,665	619,117	941,177	774,721
Tennessee	317,149	248,996	329,319	278,637	306,037	275,235
Missouri	42,255	37,813	51,570	42,730	54,358	36,243
Oklahoma	193,784	186,589	335,064	326,981	487,306	862,383
Indian Territory	351,598	278,347	469,254	350,125	410,520	
All other	1,263	772	2,019	1,416	2,270	2,734
United States	10,630,945	9,851,129	13,438,012	10,575,017	13,273,809	11,107,179
Total value of crop.	$421,687,941	$576,499,824	$561,100,386	$556,833,817	$640,311,538	$613,630,436

Condition of the cotton crop in the United States, monthly, and average yield per acre, 1890–1907.

Year.	June.	July.	August.	September.	October.	Average yield per acre (lint).	Year.	June.	July.	August.	September.	October.	Average yield per acre (lint).
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Lbs.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Lbs.*
1890	88.8	91.4	89.5	85.5	80.0	187.0	1899	85.7	87.8	84.0	68.5	62.4	184.0
1891	85.7	88.6	88.9	82.7	75.7	179.4	1900	82.5	75.8	76.0	68.2	67.0	194.0
1892	85.9	86.9	82.3	76.8	73.3	....	1901	81.5	81.1	77.2	71.4	61.4	169.0
1893	85.6	82.7	80.4	73.4	70.7	149.0	1902	95.1	84.7	81.9	64.0	58.3	188.5
1894	88.3	89.6	91.8	85.9	82.7	192.0	1903	74.1	77.1	79.7	81.2	65.1	174.5
1895	81.0	82.3	77.9	70.8	65.1	156.0	1904	83.0	88.0	91.6	84.1	75.8	204.9
1896	97.2	92.5	80.1	64.2	60.7	....	1905	77.2	77.0	74.9	72.1	71.2	186.1
1897	83.5	86.0	86.9	78.3	70.0	181.9	1906	84.6	83.3	82.9	77.3	71.6	202.5
1898	89.0	91.2	91.2	79.8	75.4	219.0	1907	70.5	72.0	75.0	72.7	67.7	178.3

COTTON CROP IN THE UNITED STATES, 1790–1907.

Intelligent use of the following table depends upon observing these explanations:

Year.—The year mentioned is, for production, that of planting and growth; but ginning continues into the following calendar year. When, in want of figures for production, a commercial crop is taken, this represents the trade movement beginning September 1 of the growth year and ending August 31 of the following year. The year for exports and imports begins October 1 of the growth year for the period 1790–1842 (1842 is a nine-months year); July 1 for 1843–1866 (1866 is a fourteen-months year); and September 1 for 1867–1906; except that the average price of exports per pound given for the years 1791–1800 (average for following and nearly coincident calendar years adopted) is derived from a report of Secretary of Treasury Woodbury (Ex. Doc. No. 146, 24th Cong., 1st sess.).

Production—number of running bales.—1790–1834 and 1839, production, total net weight in pounds divided by net weight per bale; 1835–1838, 1840–1848, 1850–1858, 1860, 1865–1868, 1870–1878, 1880–1888, 1890–1898, commercial crop, Latham, Alexander & Company's Cotton Movement and Fluctuation; 1849, 1859, 1869, 1879, 1889, 1899–1907, production, Census; 1861–1864, commercial crop, Production and Price of Cotton for One Hundred Years, by James L. Watkins, Bulletin No. 9, Bureau of Statistics, United States Department of Agriculture. Linters included, 1899–1907. Number of running bales of linters, 1899, 114,544; 1900, 143,500; 1901, 166,026; 1902, 196,223; 1903, 195,752; 1904, 245,973; 1905, 230,497; 1906, 322,064; 1907, 268,060.

Production—500-pound bales.—Linters included, 1899–1907, with same number of bales as above for 1899–1902; 500-pound bales in 1903, 194,486; 1904, 241,942; 1905, 229,539; 1906, 321,689; 1907, 268,282.

Production—net weight per bale.—1790–1898, Bulletin No. 9, above, and Latham, Alexander & Company, above, except that for the census crops of 1849, 1859, and 1869, the equivalent 400-pound bale, net lint, computed for the census, is adopted; 1899–1907, Census. Linters not included.

Production—total net weight.—1790–1834, production, report of Secretary Woodbury, above; 1839, production, Census; 1835–1838, 1840–1848, 1850–1858, 1860–1868, 1870–1878, 1880–1888, 1890–1898, commercial crop, and 1849, 1859, 1869, 1879, 1889, 1899–1907, production, number of bales multiplied by average net weight per bale. Linters not included.

Price per pound of lint.—1869–1898, and 1907, farm price, December 1, Bureau of Statistics, Department of Agriculture, specific inquiry; 1899, Census, total farm value divided by total net weight; 1900–1901, no information; 1902–1907, Census, New Orleans Cotton Exchange value for upland cotton, computed by multiplying total net weight by mean exchange price for estimated average grade, and Charleston and Savannah Cotton Exchange value for sea-island cotton. Linters not included.

Total value of lint.—Total net weight multiplied by price per pound, except for 1899. Linters not included, because included in value of seed, which was in total as follows for the only years for which ascertainable: At the farm, 1899, $46,950,575; at the mill, 1902, $80,209,194; 1903, $84,049,406; 1904, $90,931,250; 1905, $75,464,515; 1906, $81,335,699; 1907, $87,325,575.

Consumption.—Linters included, 1899–1906. No account taken of stocks at beginning and end of year. The figures are from the formula of production plus net imports minus domestic exports, and do not stand for actual consumption for any certain year, concerning which see Bul. No. 63, Bureau of the Census.

Domestic exports.—Including reexports, 1790–1800, not including reexports, 1801–1819, American State Papers; 1820–1906, Bureau of Statistics, Department of Commerce and Labor. Linters included, 1897–1906; uncertain whether included before 1897 and after this class of cotton first appeared in trade, soon after 1870.

Net imports.—Imports, including reexports, 1790–1800, not including reexports, 1801–1818, American State Papers; 1819, Report of Secretary Woodbury, above; 1820–1906, Bureau of Statistics, Department of Commerce and Labor; except that the imports given for the years 1791–1793 are for the following calendar years, being nearly coincident with the commercial crop years.

Linters.—1899–1907, included in production of running bales and equivalent 500-pound bales, and in consumption. Included in domestic exports, as explained above.

Gold values.—All values have been reduced to gold for 1862–1878.

Bureau of the Census.—In the preparation of the following table the Bureau of Statistics of the Department of Agriculture has been favored with the cooperation of the Bureau of the Census of the Department of Commerce and Labor.

Production, value, consumption, domestic exports, and net imports of cotton for the United States, 1790–1907.

Year.	Production or trade.				Value of lint at farm or exchange.		Retained for consumption, in 500-pound bales, gross weight.		Domestic exports, beginning in year mentioned.			Net imports, beginning in year mentioned.	
	Running bales, counting round as half bales.	Equivalent 500-pound bales, gross weight.	Net weight per bale of lint.	Total net weight of lint.	Price per pound.	Total value.	Quantity.	Per cent of production or trade.	Gross weight.	Equivalent 500-pound bales, gross weight.	Export price per pound, gross weight.	Net weight.	Equivalent 500-pound bales, gross weight.
	Number.	*Number.*	*Pounds.*	*Pounds (000 omitted).*	*Cents.*	*Dollars.*	*Number.*	*Per cent.*	*Pounds (000 omitted).*	*Number.*	*Cents.*	*Pounds (000 omitted).*	*Number.*
1790	6,667	3,138	225	1,500	......	....	3,457	110.2	189	379	25.0	333	697
1791	8,889	4,184	225	2,000	......	....	5,020	120.0	138	277	29.0	532	1,112
1792	13,333	6,276	225	3,000	......	....	10,681	170.0	549	1,097	32.0	2,630	5,503
1793	22,222	10,460	225	5,000	......	....	12,023	114.9	1,782	3,565	33.0	2,451	5,127
1794	35,556	16,736	225	8,000	......	....	15,914	95.1	4,707	9,414	36.5	4,107	8,592
1795	35,556	16,736	225	8,000	......	....	13,259	79.2	6,107	12,213	36.5	4,176	8,737
1796	44,444	20,921	225	10,000	......	....	20,681	98.9	3,788	7,577	34.0	3,507	7,336
1797	48,889	23,013	225	11,000	......	....	12,054	52.4	9,360	18,720	39.0	3,710	7,761
1798	66,667	31,381	225	15,000	......	....	19,849	63.3	9,532	19,065	44.0	3,600	7,532
1799	88,889	41,841	225	20,000	......	....	15,131	36.2	17,790	35,580	28.0	4,240	8,870
1800	153,509	73,222	228	35,000	......	....	40,096	54.8	20,911	41,822	44.0	4,157	8,696
1801	210,526	100,418	228	48,000	......	....	52,480	52.3	23,884	47,768	19.1	*a* 81	*a* 170
1802	231,092	115,063	238	55,000	......	....	38,486	33.4	37,712	75,424	19.3	*a* 551	*a* 1,153
1803	222,222	125,523	270	60,000	......	....	55,638	44.3	35,034	70,068	20.1	87	183
1804	261,044	135,983	249	65,000	......	....	59,659	43.9	38,390	76,780	24.6	218	456
1805	304,348	146,444	230	70,000	......	....	76,091	52.0	35,657	71,315	23.4	459	961
1806	285,714	167,364	280	80,000	......	....	40,961	24.5	63,944	127,889	22.3	710	1,485
1807	289,855	167,364	276	80,000	......	....	152,401	91.1	10,630	21,261	20.9	3,010	6,297
1808	334,821	156,904	224	75,000	......	....	53,323	34.0	50,990	101,981	16.7	*a* 765	*a* 1,601
1809	328,000	171,548	250	82,000	......	....	*b* 15,534	9.1	93,261	186,523	16.2	*a* 268	*a* 560
1810	286,195	177,824	297	85,000	......	....	54,139	30.4	62,058	124,116	15.6	206	431
1811	325,203	167,364	246	80,000	......	....	110,487	66.0	28,887	57,775	10.7	429	897
1812	304,878	156,904	246	75,000	......	....	121,817	77.6	19,110	38,220	12.2	1,497	3,133
1813	304,878	156,904	246	75,000	......	....	121,547	77.5	17,729	35,458	15.1	48	101
1814	254,545	146,444	275	70,000	......	....	*b* 19,820	13.5	82,999	165,997	21.1	*a* 127	*a* 266
1815	369,004	209,205	271	100,000	......	....	45,267	21.6	81,947	163,894	29.4	*a* 21	*a* 44
1816	439,716	259,414	282	124,000	......	....	90,164	34.8	85,649	171,299	26.4	979	2,048
1817	465,950	271,967	279	130,000	......	....	90,111	33.1	92,471	184,942	33.2	1,475	3,086
1818	446,429	261,506	280	125,000	......	....	81,058	31.0	87,997	175,994	24.0	*a* 2,129	*a* 4,454
1819	632,576	349,372	264	167,000	......	....	89,081	25.5	127,860	255,720	17.4	*a* 2,185	*a* 4,571
1820	575,540	334,728	278	160,000	......	....	85,369	25.5	124,893	249,787	16.1	204	427
1821	636,042	376,569	283	180,000	......	....	87,023	23.1	144,675	289,350	16.6	*a* 94	*a* 196
1822	704,698	439,331	298	210,000	......	....	91,995	20.9	173,723	347,447	11.8	53	110
1823	656,028	387,029	282	185,000	......	....	103,221	26.7	142,370	284,739	15.4	446	932

1824	751,748	449,791	286	215,000			96,917	21.5	176,450	352,900	20.9	13	26
1825	817,308	533,473	312	255,000			124,482	23.3	204,535	409,071	12.2	38	79
1826	1,057,402	732,218	331	350,000			143,672	19.6	294,310	588,620	10.0	35	74
1827	805,970	564,854	335	270,000			144,271	25.5	210,590	421,181	10.7	285	597
1828	953,079	679,916	341	325,000			150,202	22.1	264,837	529,674	10.0	a 19	a 40
1829	1,076,696	763,598	339	365,000			167,058	21.9	298,459	596,918	9.9	181	378
1830	1,026,393	732,218	341	350,000			178,280	24.3	276,980	553,960	9.1	10	22
1831	1,069,444	805,439	360	385,000			160,987	20.0	322,215	644,430	9.8	a 10	a 22
1832	1,114,286	815,900	350	390,000			166,571	20.4	324,699	649,397	11.1	33	69
1833	1,225,895	930,962	363	445,000			161,834	17.4	384,718	769,436	12.9	147	308
1834	1,253,406	962,343	367	460,000			189,199	19.7	387,359	774,718	16.8	752	1,574
1835	1,360,725	1,061,821	373	507,550			214,986	20.2	423,631	847,263	16.8	204	427
1836	1,423,930	1,129,016	379	539,669			240,082	21.3	444,212	888,423	14.2	a 244	a 510
1837	1,801,497	1,428,384	379	682,767			236,835	16.6	595,952	1,191,905	10.3	170	355
1838	1,360,532	1,092,980	384	522,444			266,051	24.3	413,624	827,248	14.8	153	319
1839	2,063,915	1,653,722	383	790,479			166,137	10.0	743,941	1,487,882	8.6	142	297
1840	1,634,954	1,347,640	394	644,172			288,442	21.4	530,204	1,060,408	10.2	578	1,210
1841	1,683,574	1,398,282	397	668,379			228,955	16.4	584,717	1,169,434	8.1	51	107
1842	2,378,875	2,035,481	409	972,960			452,722	22.2	792,297	1,584,594	6.2	877	1,835
1843	2,030,409	1,750,060	412	836,529			423,311	24.2	663,633	1,327,267	8.1	247	517
1844	2,394,503	2,078,910	415	993,719			332,418	16.0	872,906	1,745,812	5.9	a 325	a 680
1845	2,100,537	1,806,110	411	863,321			711,380	39.4	547,558	1,095,116	7.8	185	386
1846	1,778,651	1,603,763	431	766,599			549,445	34.3	527,220	1,054,440	10.1	58	122
1847	2,439,786	2,128,433	417	1,017,391			500,443	23.5	814,274	1,628,549	7.6	267	558
1848	2,866,938	2,615,031	436	1,249,985			561,849	21.5	1,026,602	2,053,204	6.5	10	22
1849	2,469,093	2,066,187	400	987,637			795,909	29.1	635,382	1,270,763	11.3	232	485
1850	2,454,442	2,136,083	416	1,021,048			281,939	13.2	927,237	1,854,474	12.1	158	330
1851	3,126,310	2,799,290	428	1,338,061			613,340	21.9	1,093,231	2,186,461	8.0	245	512
1852	3,416,214	3,130,338	438	1,496,302			908,621	29.0	1,111,570	2,223,141	9.8	680	1,423
1853	3,074,979	2,766,194	430	1,322,241			791,669	28.6	987,833	1,975,666	9.5	545	1,141
1854	2,982,634	2,708,082	434	1,294,463			695,657	25.7	1,008,425	2,016,849	8.7	2,115	4,425
1855	3,665,557	3,220,782	420	1,539,534			520,213	16.2	1,351,432	2,702,863	9.5	1,097	2,295
1856	3,093,737	2,873,680	444	1,373,619			778,794	27.1	1,048,282	2,096,565	12.6	802	1,678
1857	3,257,339	3,012,016	442	1,439,744			774,768	25.7	1,118,624	2,237,248	11.7		
1858	4,018,914	3,758,273	447	1,796,455			985,335	26.2	1,386,469	2,772,937	11.6		
1859	5,387,052	4,507,993	400	2,154,821			972,620	21.6	1,767,686	3,535,373	10.9		
1860	3,849,469	3,841,416	477	1,836,197			3,226,384	84.0	307,516	615,032	11.1		
1861	4,500,000	4,490,586	477	2,146,500			4,542,187	101.1	5,065	10,129	22.9	29,507	61,731
1862	1,600,000	1,596,653	477	763,200			1,641,578	102.8	11,385	22,770	42.6	32,358	67,695
1863	450,000	449,059	477	214,650			477,476	106.3	11,994	23,988	52.8	25,050	52,405
1864	300,000	299,372	477	143,100			350,382	117.0	8,894	17,789	38.1	32,886	68,798
1865	2,269,316	2,093,658	441	1,000,768			802,834	38.3	650,573	1,301,146	30.8	4,934	10,322
1866	2,097,254	1,948,077	444	931,181			545,344	28.0	700,849	1,401,697	21.4	a 495	a 1,035
1867	2,519,554	2,345,610	445	1,121,202			843,199	35.9	751,378	1,502,756	13.7	165	345
1868	2,366,467	2,198,141	444	1,050,711			899,563	40.9	650,224	1,300,449	18.6	894	1,870
1869	3,011,996	2,520,499	400	1,204,798	16.5	198,791,736	535,817	21.3	993,854	1,987,708	19.5	1,446	3,026
1870	4,352,317	4,024,527	442	1,923,724	12.1	232,770,618	1,103,573	27.4	1,461,378	2,922,757	13.3	861	1,802
1871	2,974,351	2,756,564	443	1,317,637	17.9	235,857,111	938,002	34.0	912,468	1,824,937	17.5	3,047	6,374
1872	3,930,508	3,650,932	444	1,745,146	16.5	287,949,016	1,190,358	32.6	1,235,295	2,470,590	16.4	4,788	10,016
1873	4,170,388	3,873,750	444	1,851,652	14.1	261,082,970	1,194,661	30.8	1,341,315	2,682,631	14.6	1,693	3,541
1874	3,832,991	3,528,276	440	1,686,516	13.0	219,247,085	1,027,942	29.1	1,252,059	2,504,118	13.3	1,809	3,784

a Excess of foreign exports over total imports.

b Excess of domestic exports over production and net imports.

Production, value, consumption, domestic exports, and net imports of cotton for the United States, 1790–1907—Continued.

Year.	Production or trade.				Value of lint at farm or exchange.		Retained for consumption, in 500-pound bales, gross weight.		Domestic exports, beginning in year mentioned.			Net imports, beginning in year mentioned.	
	Running bales, counting round as half bales.	Equivalent 500-pound bales, gross weight.	Net weight per bale of lint.	Total net weight of lint.	Price per pound.	Total value.	Quantity.	Per cent of production or trade.	Gross weight.	Equivalent 500-pound bales, gross weight.	Export price per pound, gross weight.	Net weight.	Equivalent 500-pound bales, gross weight.
	Number.	*Number.*	*Pounds.*	*Pounds (000 omitted).*	*Cents.*	*Dollars.*	*Number.*	*Per cent.*	*Pounds (000 omitted).*	*Number.*	*Cents.*	*Pounds (000 omitted).*	*Number.*
1875	4,632,313	4,302,818	444	2,056,747	11.1	228,298,914	1,269,666	29.5	1,518,825	3,037,650	11.3	2,150	4,498
1876	4,474,069	4,118,390	440	1,968,590	9.9	194,890,446	1,283,804	31.2	1,419,709	2,839,418	11.1	2,310	4,832
1877	4,773,865	4,494,224	450	2,148,239	10.5	225,565,121	1,301,832	29.0	1,598,719	3,197,439	11.0	2,412	5,046
1878	5,074,155	4,745,078	447	2,268,147	8.2	185,988,077	1,459,961	30.8	1,645,083	3,290,167	10.0	2,414	5,049
1879	5,755,359	5,466,387	454	2,612,933	10.2	266,519,165	1,731,213	31.7	1,871,376	3,742,752	11.6	3,622	7,578
1880	6,605,750	6,356,998	460	3,038,645	9.8	297,787,210	1,908,949	30.0	2,226,748	4,453,495	11.3	2,604	5,447
1881	5,456,048	5,136,447	450	2,455,222	10.0	245,522,160	1,763,186	34.3	1,688,261	3,376,521	11.5	1,559	3,261
1882	6,949,756	6,833,442	470	3,266,385	9.9	323,372,147	2,246,826	32.9	2,295,666	4,591,331	10.8	2,254	4,716
1883	5,713,200	5,521,963	462	2,639,498	9.0	237,554,856	1,799,842	32.6	1,866,684	3,733,369	10.6	5,376	11,247
1884	5,706,165	5,491,288	460	2,624,836	9.2	241,484,903	1,768,262	32.2	1,865,085	3,730,170	10.7	3,415	7,144
1885	6,575,691	6,369,341	463	3,044,545	8.5	258,786,319	2,176,965	34.2	2,100,323	4,200,647	9.9	3,953	8,270
1886	6,505,087	6,314,561	464	3,018,360	8.1	247,140,771	2,020,571	32.0	2,150,771	4,301,542	9.5	3,610	7,552
1887	7,046,833	6,884,667	467	3,290,871	8.5	279,724,037	2,377,396	34.5	2,259,627	4,519,254	9.9	5,728	11,983
1888	6,938,290	6,923,775	477	3,309,564	8.5	281,312,968	2,208,867	31.9	2,365,096	4,730,192	10.0	7,306	15,284
1889	7,472,511	7,472,511	478	3,571,860	8.3	296,464,401	2,561,923	34.3	2,464,461	4,928,921	10.2	8,764	18,334
1890	8,652,597	8,562,089	473	4,092,678	8.6	351,970,341	2,757,449	32.2	2,925,110	5,850,219	10.0	21,787	45,580
1891	9,035,379	8,940,867	473	4,273,734	7.3	311,982,601	3,108,461	34.8	2,948,400	5,896,800	8.8	30,780	64,394
1892	6,700,365	6,658,313	475	3,182,673	8.4	267,344,564	2,258,798	33.9	2,242,625	4,485,251	8.5	40,981	85,735
1893	7,549,817	7,486,639	474	3,578,613	7.0	250,502,928	2,238,750	29.9	2,653,647	5,307,295	7.8	28,396	59,405
1894	9,901,251	10,025,534	484	4,792,205	4.6	220,441,452	3,163,561	31.6	3,480,686	6,961,372	5.8	47,513	99,399
1895	7,157,346	7,142,372	477	3,414,054	7.6	259,468,107	2,492,869	34.9	2,380,752	4,761,505	8.2	53,537	112,001
1896	8,757,964	8,739,642	477	4,177,549	6.6	275,718,223	2,728,170	31.2	3,063,092	6,126,185	7.4	54,832	114,712
1897	11,199,994	11,293,718	482	5,398,397	6.6	356,294,209	3,560,052	31.5	3,919,734	7,839,467	6.0	50,573	105,802
1898	11,274,840	11,534,303	489	5,513,397	5.7	314,263,615	3,982,244	34.5	3,827,641	7,655,281	5.6	49,341	103,223
1899	9,507,786	9,459,935	476	4,467,097	7.24	323,758,171	3,373,173	35.7	3,110,770	6,221,541	7.9	64,424	134,778
1900	10,245,602	10,266,527	480	4,846,471	....	....	3,522,221	34.3	3,430,458	6,860,917	9.3	55,739	116,610
1901	9,478,546	9,675,771	489	4,550,950	....	....	2,937,153	30.4	3,464,349	6,928,697	8.3	90,858	190,080
1902	10,784,473	10,827,168	481	5,091,641	8.28	421,687,941	4,015,401	37.1	3,480,440	6,960,880	9.0	71,276	149,113
1903	10,015,721	10,045,615	480	4,716,591	12.22	576,499,824	3,855,669	38.4	3,145,122	6,290,245	12.0	47,942	100,298
1904	13,697,310	13,679,954	478	6,426,698	8.73	561,100,386	4,690,522	34.3	4,559,807	9,119,614	8.9	62,227	130,182
1905	10,725,602	10,804,556	482	5,060,205	11.00	556,833,818	3,962,526	36.7	3,487,747	6,975,494	11.0	63,796	133,464
1906	13,305,265	13,595,498	490	6,354,108	10.08	640,311,538	4,982,323	36.6	4,412,618	8,825,237	10.7	101,365	212,061
1907	11,325,882	11,375,461	480	5,302,949	10.4	551,506,096	....	....	....	....	....	....	....

Closing prices middling upland cotton per pound, 1903–1907.

Date.	New York. Low.	New York. High.	New Orleans. Low.	New Orleans. High.	Memphis. Low.	Memphis. High.	Galveston. Low.	Galveston. High.	Savannah. Low.	Savannah. High.	Charleston. Low.	Charleston. High.	Wilmington. Low.	Wilmington. High.	Norfolk. Low.	Norfolk. High.
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Jan	8.85	9.05	8 7/16	8⅞	8½	8¾	8⅝	8 15/16	8⅜	8¾	8¼	8⅝	8¼	8½	8⅝	9
Feb	9.00	10.25	8⅞	9⅞	8¾	9⅞	8 15/16	10 1/16	8¾	9⅞	8⅝	9¾	8½	9¾	9	10
Mar	9.90	10.45	9 9/16	9⅞	9 11/16	9 15/16	9⅞	10 1/16	9⅝	9⅞	9½	9¾	9½	9¾	9¾	10
Apr	9.90	10.75	9¾	10 3/16	9¾	10	9⅞	10⅛	9⅝	10	9½	10	9½	9¾	10	10½
May	10.75	12.15	10 3/16	11 11/16	10	11⅜	10⅛	11½	10	11¼	10	11	10	10½	10⅜	11⅜
June	11.50	13.35	11 11/16	13⅝	11⅜	13 5/16	11 7/16	12¾	11¼	12½	.....	11	.....	10½	11⅜	13
July	11.60	13.50	12⅝	13⅝	12 7/16	13 5/16	12	12¾	12¼	13⅛	.....	.....	.....	.....	12	13
Aug	12.75	12.75	12½	13¼	12 7/16	12 15/16	12	12⅛	12⅛	13⅛	12¼	12¼	.....	.....	12½	12½
Sept	11.25	13.00	9¾	12½	9¾	12 9/16	10	12⅛	9 7/16	12½	9½	11⅞	9½	11¼	9¾	12½
Oct	9.50	10.60	9⅛	10¼	9½	10⅛	9 5/16	10 3/16	9 1/16	10¼	9	10	9	10⅛	9¼	10 3/16
Nov	10.50	11.65	10	11 3/16	10 1/16	11⅛	10⅛	11 3/16	10⅛	11⅛	10	10⅞	10	11	10¼	11⅜
Dec	11.95	14.10	11½	13⅝	11¼	13½	11 7/16	13⅜	11⅜	13⅜	11	13½	11	12¾	11¾	13¾
1904.																
Jan	13.10	16.75	13	15 15/16	13	15⅜	12¾	15 5/16	12⅝	15⅞	12½	15¾	12¾	15	13	16
Feb	13.50	17.25	13¼	16 7/16	13¼	16½	13½	16	13¼	16¼	14	16	13	15½	13	16½
Mar	14.00	16.65	14	16	14	15 13/16	14	15 15/16	14½	15¾	14½	15¾	14	15¾	14	16¼
Apr	13.75	15.45	13⅞	15 5/16	13⅞	15⅛	14	15 3/16	13¾	14¾	14½	15⅝	.....	.....	14	15¼
May	12.75	13.90	12⅝	13 3/16	12½	13⅞	12⅝	13 13/16	12⅞	13¾	.....	.....	.....	.....	13	14
June	10.85	12.85	10¾	12⅛	10½	12	10½	12½	10¾	12¾	.....	.....	.....	.....	10¾	12⅛
July	10.60	11.25	10½	11 1/16	10⅜	11	10½	10 13/16	10¾	11⅛	.....	.....	.....	.....	10⅝	11¼
Aug	10.45	11.65	10¼	11 3/16	10⅛	11	10½	11⅛	10⅜	11	.....	.....	.....	.....	10⅜	11
Sept	10.70	11.30	10	11 3/16	10¼	11	10¼	11⅛	9 15/16	11⅛	10	10 3/16	10 5/16	10 5/16	10	11
Oct	9.90	10.65	9½	10 3/16	9½	10 3/16	9⅝	10 1/16	9½	9 15/16	9¼	9 13/16	.....	.....	9½	10 3/16
Nov	9.30	10.25	8⅞	9 11/16	8⅞	9 11/16	8 15/16	9 13/16	8¾	9 11/16	9	9 9/16	9	9⅝	9	9 13/16
Dec	6.85	9.00	6½	8 9/16	6¾	8⅝	6⅝	8 9/16	6½	8½	6½	8¼	.....	.....	6¾	8⅝
1905.																
Jan	7.00	7.35	6⅝	7	6¾	7 11/16	6¾	7 1/16	6⅝	7	6⅝	6⅞	.....	.....	6¾	7⅛
Feb	7.35	8.90	7	7 11/16	7⅛	7 7/16	7½	7 13/16	7	7 11/16	6¾	7½	6¾	7½	7⅛	7⅞
Mar	7.75	8.30	7¼	7 11/16	7⅜	7 11/16	7½	7 13/16	7⅜	7 13/16	7¼	7¾	7¼	7⅝	7⅝	8
Apr	7.55	8.15	7⅜	7 5/16	7⅜	7 9/16	7⅜	7 11/16	7⅛	7 9/16	7	7 5/16	7¼	7½	7⅜	7⅞
May	7.85	8.85	7½	8 7/16	7⅝	8¾	7⅝	8 11/16	7¼	8½	7¼	8¼	7¼	8¼	7⅝	8⅝
June	8.40	10.15	8¼	9 9/16	8⅜	9 13/16	8¼	9 5/16	8⅛	9⅝	7⅞	8 5/16	8	8⅝	8¼	9¾
July	10.00	11.40	9¾	11⅛	9 13/16	11 1/16	9⅞	11 3/16	9⅝	10⅞	10	10⅝	.....	.....	9¾	11
Aug	10.50	11.35	10⅜	10 9/16	10⅛	10⅝	10½	10 11/16	10¼	10 11/16	10¼	10⅝	.....	10⅜	10½	11
Sept	10.65	11.10	10⅛	10 7/16	10⅛	10 11/16	10⅛	10 11/16	9⅞	10 5/16	9⅞	10 7/16	10	10⅜	10¼	10 9/16
Oct	9.85	10.75	9¾	10 11/16	9⅞	10 3/16	9¾	10 9/16	9 7/16	10 7/16	9½	10 3/16	9½	10¼	9⅝	10⅝
Nov	10.90	12.00	10¾	11 9/16	11	11 15/16	10¾	11 5/16	10⅜	11 5/16	10¼	11¼	10⅜	11¼	10⅝	11 9/16
Dec	11.65	12.60	11⅜	12 1/16	11½	12⅛	11½	12	11¾	11 11/16	11	11 5/16	11⅛	11⅜	11⅜	12
1906.																
Jan	11.35	12.25	11¼	11 11/16	11¼	11 11/16	11	11 1/16	10⅞	11 7/16	11	11⅜	11	11¼	11¼	11¾
Feb	10.80	11.45	10⅝	10 11/16	10¾	11 3/16	10¾	11	10⅜	10 11/16	10⅛	10 11/16	10¼	10½	10⅝	11
Mar	10.95	11.80	10½	11 1/16	10¾	11¼	10¾	11 5/16	10⅜	11⅛	10¼	11	10¼	11	10½	11 3/16
Apr	11.55	11.90	11⅛	11 7/16	11⅛	11 5/16	11¼	11 7/16	11	11 3/16	10⅞	11⅛	11	11¼	11¼	11⅝
May	11.25	12.00	11⅛	11 7/16	11¼	11 7/16	11⅛	11 9/16	11	11 5/16	11	11 3/16	11	11 3/16	11¼	11 7/16
June	10.80	11.30	10⅞	11 1/16	10¾	11	11⅛	11 1/16	10¾	11¾	10⅝	10 9/16	10¾	10 13/16	11	11¼
July	10.80	11.00	10⅝	11⅛	10¾	11	10⅞	11 1/16	10¾	10 11/16	.....	.....	10¼	10¾	11	11 1/16
Aug	9.80	10.90	9⅜	10 5/16	9⅝	10¾	9¼	10 3/16	9¾	10⅞	9	9¼	9	10 9/16	9¾	11 1/16
Sept	9.60	10.00	9⅜	9 5/16	9⅜	9 9/16	9¼	9 15/16	8⅞	9 3/16	8¾	9¼	9	9 3/16	9⅜	9 7/16
Oct	10.25	11.40	9 11/16	11 3/16	10 1/16	11½	9⅞	11 5/16	9⅝	10 15/16	9⅞	11	9½	11	9 15/16	11 5/16
Nov	10.10	11.40	9⅝	11 3/16	9⅞	11	9⅞	11 3/16	9⅜	10 15/16	9¼	10⅝	9⅝	10 9/16	10	11¼
Dec	10.45	11.25	10⅛	11⅜	10¼	11 1/16	10¼	11⅜	9¾	10 7/16	9½	10 3/16	9⅝	10⅝	10⅛	11¼
1907.																
Jan	10.70	11.00	10¼	10 9/16	10¼	10 9/16	10½	10 11/16	9⅞	10 9/16	9¾	10	9⅞	10 3/16	10¼	10⅝
Feb	11.00	11.25	10½	10 9/16	10 7/16	10 9/16	10¾	11 1/16	10⅛	10 5/16	10	10 3/16	10⅛	10⅛	10½	10⅞
Mar	10.90	11.45	10⅝	11 1/16	10⅜	10 11/16	10 13/16	11 7/16	10⅜	10⅝	10⅜	10⅝	10⅜	10⅝	11	11¼
Apr	10.90	11.45	10½	11 3/16	10½	11⅛	10⅞	11⅝	10¼	11	10¼	10¾	10⅜	10⅞	11	11⅞
May	11.50	12.90	11½	12 7/16	11¼	12½	11⅞	12¾	11	12⅛	11	11⅞	11	12¼	12	13¼
June	12.80	13.25	12½	13	12½	12 15/16	12¾	13 1/16	12¼	12¾	.....	.....	12¼	12¼	13¼	13½
July	12.85	13.50	12⅝	13⅛	12 15/16	13 3/16	12⅞	13⅛	12⅞	13⅛	.....	.....	.....	.....	13½	13⅝
Aug	13.00	13.55	12⅝	13 9/16	13	13½	.....	.....	12⅝	13 3/16	.....	.....	.....	.....	13½	13½
Sept	11.75	13.55	11½	13 9/16	11⅞	13½	12⅛	13 9/16	11⅛	13 5/16	11⅛	13	11¼	13	11¾	13½
Oct	10.80	12.00	10⅜	11 7/16	10¾	12	11	12⅛	10	11 5/16	10	11 5/16	10	11 3/16	10⅜	11⅞
Nov	10.60	11.80	10½	11 5/16	10¾	11¼	10⅞	11 3/16	10¼	10 7/16	10⅛	10 7/16	10¼	10 7/16	10½	11¼
Dec	11.70	12.20	11⅛	11 13/16	11⅜	11¾	11½	12	10½	11 7/16	10¾	11 1/16	10 13/16	11 1/16	11⅛	11 9/16

International trade in cotton, 1902–1906.[a]

[Bales of 500 pounds, gross weight, or 478 pounds of lint, net.]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Brazil	Jan. 1	148,225	130,229	61,170	111,069	146,060
British India	Apr. 1	1,429,058	1,865,791	1,334,111	1,741,096	1,741,523
Egypt	Jan. 1	1,378,413	1,158,029	1,225,259	1,352,516	1,387,636
France	Jan. 1	117,738	152,127	150,462	164,814	169,840
Germany[b]	Jan. 1	174,250	177,173	189,609	158,722	181,056
Netherlands	Jan. 1	82,530	110,568	104,182	98,851	105,827
Peru	Jan. 1	30,826	35,289	34,741	86,730	[c]107,000
United States	July 1	7,138,284	6,179,712	8,678,644	7,268,090	9,036,434
Other countries		304,900	391,000	581,500	426,795	[c]460,872
Total		10,804,224	10,199,918	12,359,678	11,408,683	13,336,248

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	664,313	688,041	700,062	752,110	759,828
Belgium	Jan. 1	206,087	246,879	186,228	220,252	249,285
Canada	July 1	142,138	101,800	118,583	142,262	[c]151,424
France	Jan. 1	985,068	1,167,740	967,710	1,104,700	1,124,518
Germany[b]	Jan. 1	1,606,442	1,764,002	1,836,190	1,858,054	1,895,837
Italy	Jan. 1	679,641	711,035	713,733	761,328	844,118
Japan	Jan. 1	946,919	816,657	733,849	1,184,213	842,749
Mexico	July 1	77,590	64,680	86,198	31,210	[c]1,982
Netherlands	Jan. 1	182,427	199,729	203,091	210,026	208,638
Russia	Jan. 1	820,955	1,061,822	908,232	791,248	[c]753,004
Spain	Jan. 1	392,993	368,653	325,157	352,245	401,409
Sweden	Jan. 1	83,166	83,194	80,325	89,154	95,207
United Kingdom	Jan. 1	3,225,052	3,113,890	3,559,028	4,017,610	3,686,006
United States	July 1	156,641	102,177	126,587	148,459	219,230
Other countries		441,200	389,700	459,100	386,484	[c]380,614
Total		10,610,632	10,879,999	11,004,073	12,049,355	11,613,849

[a] See "General note," p. 615. [b] Not including free ports prior to March 1, 1906. [c] Preliminary.

International trade in cottonseed oil, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Gallons.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
Belgium	Jan. 1	877,851	670,655	714,319	1,252,803	1,218,611
Egypt	Jan. 1	479,155	426,148	397,446	249,843	360,883
France	Jan. 1	375,361	394,169	213,087	511,743	602,856
Netherlands	Jan. 1	44,328	230,762	168,425	168,686	108,062
United Kingdom	Jan. 1	8,299,636	6,725,236	4,865,745	5,323,636	7,654,982
United States	July 1	35,642,994	29,013,743	51,535,580	43,793,519	41,880,304
Other countries		72,000	11,000	1,000	38,003	11,796
Total		45,791,325	37,471,713	57,895,602	51,338,233	51,837,494

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Algeria	Jan. 1	395,948	358,204	625,340	1,163,468	[b]1,163,468
Australia	Jan. 1	64,252	75,799	105,630	178,797	54,094
Austria-Hungary	Jan. 1	3,367,889	4,253,976	4,505,589	5,499,759	5,864,466
Belgium	Jan. 1	2,473,051	1,450,415	1,591,592	3,037,814	2,698,477
Brazil	Jan. 1	1,174,250	923,463	840,327	759,755	947,023
Canada	July 1	1,112,940	905,169	1,082,099	1,337,763	[c]1,626,028
Egypt	Jan. 1	115,782	256,211	149,587	416,962	153,722
France	Jan. 1	7,464,358	5,691,156	6,130,298	11,082,265	9,859,577
Germany[d]	Jan. 1	15,889,198	11,420,314	11,347,562	16,767,840	16,203,800
Italy	Jan. 1	777,430	1,051,462	1,225,569	3,429,991	786,563
Malta	Apr. 1	254,803	364,105	285,903	235,683	[b]235,683
Martinique	Jan. 1	166,981	285,034	277,114	300,232	[b]300,232
Mexico	July 1	3,559,783	4,066,361	3,158,044	3,961,818	4,077,746
Netherlands	Jan. 1	5,769,104	3,271,886	3,183,920	4,764,653	5,418,951
Senegal	Jan. 1	412,946	351,119	294,713	387,607	[b]387,607
United Kingdom	Jan. 1	[e]2,706,618	[e]2,706,618	2,706,618	4,048,873	3,224,727
Uruguay	July 1	297,602	352,063	285,677	342,341	[b]342,341
Other countries		463,000	541,000	699,000	792,753	2,868,506
Total		46,465,935	38,324,355	38,494,582	58,508,374	56,213,011

[a] See "General note," p. 615.
[b] Year preceding.
[c] Preliminary.
[d] Not including free ports prior to March 1, 1906.
[e] 1904 figures.

TOBACCO.

Tobacco crop of countries named, 1902–1906.

[Production for South America (especially Brazil) largely understated, because domestic consumption is unknown. No statistics for China, Persia, Central America (except Guatemala), West Indies (except Cuba and Porto Rico), and several less important tobacco-growing countries.]

Country.	1902.	1903.	1904.	1905.	1906.
NORTH AMERICA					
United States:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Contiguous	821,824,000	815,972,000	660,461,000	633,034,000	682,429,000
Noncontiguous—Porto Rico[a]	8,000,000	5,000,000	5,000,000	6,000,000	8,000,000
Total United States (except Philippine Islands).	829,824,000	820,972,000	665,461,000	639,034,000	690,429,000
Canada:					
Ontario	3,071,000	2,423,000	3,035,000	[a] 6,275,000	[a] 7,575,000
Quebec	[b] 5,000,000	[b] 5,000,000	[b] 5,000,000	[a] 3,100,000	[a] 3,750,000
Other	[c] 107,000	[c] 107,000	[c] 107,000	[c] 107,000	[c] 107,000
Total Canada	8,178,000	7,530,000	8,142,000	9,482,000	11,432,000
Cuba	57,177,000	[a] 38,731,000	[a] 42,421,000	[a] 48,783,000	[a] 28,629,000
Guatemala	1,063,000	1,065,000	1,100,000	1,983,000	[d] 1,300,000
Mexico	[a] 20,000,000	29,156,000	28,880,000	[a] 23,000,000	[a] 23,000,000
Total North America	916,242,000	897,454,000	746,004,000	722,282,000	754,790,000
SOUTH AMERICA.					
Argentina	[d] 31,000,000	[e] 22,000,000	[d] 31,000,000	[e] 43,000,000	[d] 31,000,000
Bolivia[d]	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Brazil[f]	99,650,000	51,583,000	52,832,000	44,953,000	52,095,000
Chile[d]	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000
Ecuador[f]	179,000	399,000	89,000	122,000	122,000
Paraguay	8,510,000	10,296,000	[a] 13,000,000	[d] 10,000,000	[d] 10,000,000
Peru[d]	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
Total South America	149,839,000	94,778,000	107,421,000	108,575,000	103,717,000
EUROPE.					
Austria-Hungary:					
Austria	12,938,000	15,895,000	14,047,000	14,360,000	17,884,000
Hungary	99,228,000	134,567,000	88,768,000	103,076,000	160,616,000
Bosnia-Herzegovina	[g] 9,000,000	[g] 9,000,000	[g] 9,000,000	8,753,000	[h] 8,753,000
Total Austria-Hungary	121,166,000	159,462,000	111,815,000	126,189,000	187,253,000
Belgium	11,266,000	9,685,000	13,983,000	16,646,000	15,001,000
Bulgaria	6,423,000	19,060,000	8,914,000	8,080,000	8,638,000
Denmark	363,000	342,000	[e] 340,000	[e] 340,000	[e] 340,000
France	54,610,000	57,466,000	37,767,000	53,863,000	36,416,000
Germany	83,109,000	72,911,000	75,797,000	70,240,000	70,734,000
Greece	[d] 14,000,000	[d] 14,000,000	[d] 14,000,000	20,000,000	11,000,000
Italy	11,052,000	12,188,000	13,464,000	15,605,000	[h] 15,605,000
Netherlands	2,211,000	1,771,000	[a] 1,500,000	[a] 1,500,000	[a] 1,500,000
Roumania	6,096,000	10,113,000	3,999,000	8,694,000	9,994,000
Russia	232,767,000	222,785,000	204,298,000	214,050,000	162,020,000
Servia	2,358,000	2,268,000	2,379,000	2,086,000	2,379,000
Sweden	1,636,000	1,706,000	4,118,000	2,713,000	2,663,000
Turkey[i]	[a] 71,000,000	[a] 116,000,000	[a] 90,000,000	[a] 100,000,000	[a] 100,000,000
Total Europe	618,057,000	693,757,000	582,374,000	640,006,000	623,543,000
ASIA.					
British India[a]	450,000,000	450,000,000	450,000,000	450,000,000	450,000,000
Dutch East Indies:					
Borneo	336,000	163,000	56,000	[d] 300,000	[d] 300,000
Java	57,958,000	59,274,000	44,991,000	65,316,000	[h] 65,316,000
Sumatra	46,850,000	50,721,000	45,134,000	43,635,000	[h] 43,635,000
Total Dutch East Indies	105,144,000	110,158,000	90,181,000	109,251,000	109,251,000

[a] Unofficial estimate.
[b] Estimated from census statistics for 1900.
[c] Census, 1901.
[d] Average production.
[e] Estimated from official data for acreage.
[f] Exports.
[g] Official estimate for 1904.
[h] Data for 1905.
[i] Including Asiatic Turkey.

Tobacco crop of countries named, 1902–1906—Continued.

Country.	1902.	1903.	1904.	1905.	1906.
ASIA—continued.					
Japanese Empire:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Japan	69,029,000	95,151,000	105,853,000	89,931,000	a 89,931,000
Formosa	1,095,000	1,010,000	222,000	187,000	a 187,000
Total Japanese Empire	70,124,000	96,161,000	106,075,000	90,118,000	a 90,118,000
Philippine Islands	37,499,000	b 35,900,000	b 33,100,000	b 38,200,000	b 46,800,000
Total Asia	662,767,000	692,219,000	679,356,000	687,569,000	696,169,000
AFRICA.					
Algeria	18,863,000	13,013,000	12,492,000	13,006,000	11,668,000
British Central Africa	c 60,000	c 60,000	60,000	d 199,000	d 413,000
Cape of Good Hope	b 5,000,000	b 5,000,000	5,309,000	b 5,000,000	b 5,000,000
Mauritius	26,000	28,000	29,000	13,000	a 13,000
Natal	3,479,000	4,418,000	2,907,000	2,623,000	3,103,000
Orange River Colony	c 750,000	c 750,000	750,000	650,000	a 650,000
Total Africa	28,178,000	23,269,000	21,547,000	21,491,000	20,847,000
OCEANIA.					
Australia:					
Queensland	655,000	204,000	69,000	798,000	1,146,000
New South Wales	221,000	292,000	596,000	562,000	821,000
Victoria	39,000	87,000	95,000	125,000	157,000
Total Australia	915,000	583,000	760,000	1,485,000	2,124,000
Fiji	56,000	74,000	58,000	1,000	a 1,000
Total Oceania	971,000	657,000	818,000	1,486,000	2,125,000
Grand total	2,376,054,000	2,402,134,000	2,137,520,000	2,181,409,000	2,201,191,000

a Data for 1905.
b Estimated from returns for census year.
c Official estimate for 1904.
d Exports.

Acreage, production, and value of tobacco in the United States, 1900–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per pound Dec. 1.	Farm value Dec. 1.	Domestic exports of unmanufactured, fiscal year beginning July 1.	Imports of unmanufactured, fiscal year beginning July 1.
	Acres.	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*	*Pounds.*	*Pounds.*
1900	1,046,427	778.0	814,345,341	6.6	53,661,132	315,787,782	26,851,253
1901	1,039,199	788.0	818,953,373	7.1	58,283,108	301,007,365	29,428,837
1902	1,030,734	797.3	821,823,963	7.0	57,563,510	368,184,084	34,016,956
1903	1,037,735	786.3	815,972,425	6.8	55,514,627	311,971,831	31,162,636
1904	806,409	819.0	660,460,739	8.1	53,382,959	334,302,091	33,288,378
1905	776,112	815.6	633,033,719	8.5	53,519,068	312,227,202	41,125,970
1906	796,099	857.2	682,428,530	10.0	68,232,647	340,742,864	40,898,807
1907	820,800	850.5	698,126,000	10.9	76,234,000	....	....

Condition of the tobacco crop in the United States, monthly, 1903–1907.

Year.	July.	Aug.	Sept.	When harvested.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*
1903	85.1	82.9	83.4	82.3
1904	85.3	83.9	83.7	85.6
1905	87.4	84.1	85.1	85.8
1906	86.7	87.2	86.2	84.6
1907	81.3	82.8	82.5	84.8

Acreage, production, and value of tobacco in the United States in 1907, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.[a]	Farm value Dec. 1.[a]
	Acres.	*Pounds.*	*Pounds.*	*Cents.*	*Dollars.*
New Hampshire	100	1,650	165,000	12.0	20,000
Vermont	200	1,625	325,000	12.0	39,000
Massachusetts	4,700	1,525	7,167,500	11.0	788,000
Connecticut	14,400	1,510	21,744,000	11.5	2,501,000
New York	7,100	1,150	8,165,000	6.0	490,000
Pennsylvania	32,000	1,260	40,320,000	7.5	3,024,000
Maryland	25,700	660	16,962,000	6.5	1,103,000
Virginia	98,100	760	74,556,000	10.5	7,828,000
West Virginia	4,800	720	3,456,000	10.0	346,000
North Carolina	161,400	625	100,875,000	11.0	11,096,000
South Carolina	22,300	900	20,070,000	10.7	2,147,000
Georgia	3,700	860	3,182,000	40.0	1,273,000
Florida	7,500	925	6,937,500	45.0	3,122,000
Ohio	67,200	900	60,480,000	8.4	5,080,000
Indiana	15,000	940	14,100,000	9.8	1,382,000
Illinois	1,100	800	880,000	10.0	88,000
Wisconsin	35,100	1,100	38,610,000	6.5	2,510,000
Missouri	1,500	825	1,237,500	11.0	136,000
Kentucky	270,200	890	240,478,000	10.2	24,529,000
Tennessee	46,500	800	37,200,000	9.8	3,646,000
Alabama	600	450	270,000	24.0	65,000
Mississippi	100	475	47,500	30.0	14,000
Louisiana	100	350	35,000	28.0	10,000
Texas	500	700	350,000	30.0	105,000
Arkansas	900	570	513,000	13.5	69,000
United States	820,800	850.5	698,126,000	10.2	71,411,000

[a] Prices of certain cigar types given in this table were based upon reports made in April, 1908, no market having been established on December 1.

International trade in unmanufactured tobacco, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Algeria	Jan. 1	7,601,206	8,346,919	7,524,375	6,171,178	[b] 6,171,178
Austria-Hungary	Jan. 1	20,846,465	18,967,906	21,628,003	18,687,919	19,788,467
Brazil	Jan. 1	99,473,274	51,583,095	52,832,124	44,953,473	52,094,709
British India	Apr. 1	23,999,313	23,375,964	25,000,133	26,288,482	33,774,412
Bulgaria	Jan. 1	4,087,076	3,763,682	1,323,732	5,749,096	3,493,435
Ceylon	Jan. 1	4,925,996	4,151,994	4,321,624	4,617,805	4,390,512
Cuba	Jan. 1	34,321,335	41,576,034	28,191,707	32,808,058	28,568,069
Dutch East Indies	Jan. 1	104,152,759	113,201,769	123,004,373	108,081,973	160,376,775
Greece	Jan. 1	10,461,326	12,776,805	9,689,636	13,026,375	[c] 17,690,658
Mexico	July 1	2,669,310	3,534,917	4,648,986	3,579,960	[c] 3,295,297
Netherlands	Jan. 1	4,785,081	4,751,225	4,855,896	4,003,120	4,345,341
Philippine Islands	Jan. 1	20,196,283	19,249,094	18,640,377	19,832,747	26,685,768
Russia	Jan. 1	7,267,304	11,203,599	12,810,474	15,937,120	[c] 17,911,949
Turkey [d]	Mar. 1	39,267,984	39,267,984	39,267,984	39,267,984	39,267,984
United States	July 1	368,184,084	311,971,831	334,302,091	312,227,202	340,742,864
Other countries		3,897,000	8,737,000	4,011,000	47,163,129	[c] 49,077,795
Total		756,135,796	676,459,758	692,052,515	702,395,621	807,675,213

[a] See "General note," page 615.
[b] Year preceding.
[c] Preliminary.
[d] Exports for 1900, latest available data.

International trade in unmanufactured tobacco, 1902–1906—Continued.

IMPORTS.

County.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	Jan. 1	3,808,839	4,420,679	6,704,152	7,081,032	8,353,648
Australia	Jan. 1	5,544,080	5,156,793	6,629,793	5,371,534	7,538,329
Austria-Hungary	Jan. 1	47,650,259	51,576,911	51,898,125	50,850,488	53,661,822
Belgium	Jan. 1	19,424,223	20,982,344	24,053,826	22,141,627	21,146,214
British India	Apr. 1	3,666,148	4,963,937	4,181,826	6,778,793	5,169,478
Canada	July 1	13,380,504	14,248,303	13,859,152	14,519,658	[a] 18,463,291
Denmark	Jan. 1	9,442,396	9,900,957	10,210,707	9,744,429	10,399,202
Egypt	Jan. 1	13,970,127	14,166,786	16,006,292	16,501,051	17,076,550
Finland	Jan. 1	7,380,691	9,093,316	9,437,932	8,956,123	9,548,533
France	Jan. 1	48,619,010	56,402,809	57,368,125	66,966,994	54,816,081
Germany [b]	Jan. 1	133,982,375	137,773,884	143,445,274	178,936,160	127,971,032
Italy	Jan. 1	40,718,486	40,488,103	33,430,447	28,127,670	[a] 45,918,749
Netherlands	Jan. 1	47,201,281	52,690,827	50,279,873	42,252,451	46,588,181
Norway	Jan. 1	4,064,155	3,857,030	2,854,897	2,956,905	3,487,734
Portugal	Jan. 1	5,327,533	7,970,542	8,825,499	5,388,004	[c] 5,388,004
Spain	Jan. 1	42,488,042	42,999,521	55,741,625	48,907,491	30,043,202
Sweden	Jan. 1	8,579,174	8,585,455	11,714,014	7,221,852	8,361,847
United Kingdom	Jan. 1	77,475,143	79,048,808	80,857,485	82,444,539	83,766,884
United States	July 1	34,016,956	31,162,636	33,288,378	37,355,477	39,540,321
Other countries		49,228,000	53,185,000	54,436,000	84,184,154	[a] 85,695,761
Total		615,967,422	648,674,641	675,223,422	726,686,432	682,934,863

[a] Preliminary. [b] Not including free ports prior to March 1, 1906. [c] Year preceding.

FLAX.

Flax crop of countries named, 1904–1906.

Country.	Seed.			Fiber.		
	1904.	1905.	1906.	1904.	1905.	1906.
NORTH AMERICA.	*Bushels.*	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	23,401,000	28,478,000	25,576,000			
Canada:						
Manitoba	479,000	337,000	283,000			
Saskatchewan	171,000	411,000	733,000			
Alberta	5,000	9,000	40,000			
Total Canada	655,000	757,000	1,056,000			
Mexico	188,000	150,000	150,000			
Total North America	24,244,000	29,385,000	26,782,000			
SOUTH AMERICA.						
Argentina	36,912,000	29,133,000	23,303,000			
Uruguay	500,000	553,000	424,000			
Total South America	37,412,000	29,686,000	23,727,000			
EUROPE.						
Austria-Hungary:						
Austria	1,162,000	1,370,000	1,375,000	105,850,000	123,127,000	128,141,000
Hungary proper	188,000	229,000	200,000	19,777,000	24,510,000	25,000,000
Croatia-Slavonia	27,000	29,000	30,000	9,214,000	9,653,000	10,000,000
Bosnia-Herzegovina	3,000	3,000	4,000	1,727,000	1,428,000	1,479,000
Total Austria-Hungary	1,380,000	1,631,000	1,609,000	136,568,000	158,718,000	164,620,000
Belgium	300,000	280,000	294,000	27,385,000	25,534,000	26,843,000
Bulgaria	36,000	2,000	2,000	2,000,000	173,000	200,000
France	608,000	575,000	646,000	52,445,000	45,515,000	46,109,000
Ireland				20,924,000	24,353,000	26,934,000

Flax crop of countries named, 1904–1906—Continued.

Country.	Seed.			Fiber.		
	1904.	1905.	1906.	1904.	1905.	1906.
EUROPE—continued.	*Bushels.*	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
Italy [a]	....	....	....	41,917,000	41,917,000	41,917,000
Netherlands	459,000	437,000	365,000	22,348,000	18,440,000	21,947,000
Roumania	169,000	335,000	571,000	3,293,000	2,905,000	6,978,000
Russia:						
Russia proper	18,284,000	20,981,000	17,254,000	1,094,383,000	1,024,557,000	1,358,287,000
Poland	649,000	819,000	911,000	37,867,000	47,420,000	69,524,000
Northern Caucasia	470,000	510,000	365,000	33,315,000	23,665,000	23,119,000
Total Russia (European)	19,403,000	22,310,000	18,530,000	1,165,565,000	1,095,642,000	1,450,930,000
Servia	....	....	....	1,209,000	905,000	1,543,000
Sweden	37,000	33,000	35,000	2,070,000	2,003,000	2,000,000
Total Europe	22,392,000	25,603,000	22,052,000	1,475,724,000	1,416,105,000	1,790,021,000
ASIA.						
British India, including such native States as report	22,873,000	13,896,000	14,128,000	....	....	....
Russia:						
Central Asia	156,000	465,000	219,000	9,071,000	15,355,000	10,820,000
Siberia	630,000	649,000	615,000	33,111,000	38,260,000	45,371,000
Transcaucasia [b]	....	1,000	1,000	16,000	12,000	23,000
Total Russia (Asiatic)	786,000	1,115,000	835,000	42,198,000	53,627,000	56,214,000
Total Asia	23,659,000	15,011,000	14,963,000	42,198,000	53,627,000	56,214,000
AFRICA.						
Algeria	36,000	17,000	17,000	....	....	....
Grand total	107,743,000	99,702,000	87,541,000	1,517,922,000	1,469,732,000	1,846,235,000

[a] Average 1892–1895. [b] Includes Chernomorsk only.

Acreage, production, and value of flaxseed in the United States, 1902–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1902	3,739,700	7.8	29,284,880	105.0	30,814,661
1903	3,233,229	8.4	27,300,510	81.7	22,291,557
1904	2,263,565	10.3	23,400,534	99.3	23,228,758
1905	2,534,836	11.2	28,477,753	84.4	24,049,072
1906	2,505,927	10.2	25,576,146	101.3	25,899,165
1907	2,864,000	9.0	25,851,000	95.6	24,713,000

Condition of the flaxseed crop in the United States, monthly, 1903–1907.

Year	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1903	86.2	80.3	80.5	74.0	1906	93.2	92.2	89.0	87.4
1904	86.6	78.9	85.8	87.0	1907	91.2	91.9	85.4	78.0
1905	92.7	96.7	94.2	91.5					

Acreage, production, and value of flaxseed in the United States in 1907, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Wisconsin	36,000	14.2	515,000	100	516,000
Minnesota	474,000	10.5	4,978,000	98	4,878,000
Iowa	20,000	11.5	235,000	97	228,000
Missouri	30,000	10.0	305,000	90	275,000
North Dakota	1,700,000	8.0	13,602,000	96	13,058,000
South Dakota	480,000	10.0	4,800,000	94	4,512,000
Nebraska	16,000	11.0	174,000	95	165,000
Kansas	54,000	10.0	539,000	90	485,000
Oklahoma	6,000	15.0	90,000	80	72,000
Montana	34,000	13.0	436,000	81	353,000
Idaho	14,000	13.0	177,000	97	171,000
United States	2,864,000	9.0	25,851,000	95.6	24,713,000

Wholesale prices of flaxseed per bushel, 1903–1907.

Date.	St. Louis.		Cincinnati.		Chicago.		Milwaukee.		Duluth.	
	Prime.				No. 1.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.										
January	$1.12	$1.17	$1.30	$1.30	$1.14	$1.24	$1.21	$1.24	$1.14½	$1.20
February	1.10	1.14	1.30	1.30	1.12	1.22	1.16	1.22	1.11¾	1.16½
March	1.05	1.12	1.30	1.30	1.06	1.17	1.00	1.17	1.07¾	1.13½
April	1.05	1.08	1.10	1.30	1.06	1.12	1.09	1.11½	1.08¾	1.11
May	1.07	1.17	1.00	1.10	1.08	1.17½	1.11	1.17½	1.10¼	1.16
June	.95	1.08	1.00	1.00	.98	1.14	1.01½	1.14	.99½	1.13
July	.91	.96	1.00	1.00	.90	1.02½	.95½	1.02½	.95	1.00¾
August	.91	1.00	1.00	1.00	.93	1.05	.97	1.05	.96¾	1.01½
September	.92	1.00	1.00	1.00	.94	1.09	.99	1.09	.99	1.09
October	.86	.93	1.00	1.00	.89	1.03½	.94½	1.04	.92	1.02¾
November	.86	.89	1.00	1.00	.90	1.00	.94	1.00	.93½	1.00
December	.87½	.90½	1.00	1.00	.90½	1.02½	.97½	1.01½	.95¾	1.00
1904.										
January	.92½	1.07	1.00	1.00	.97	1.19	1.03½	1.19	1.01½	1.17
February	1.06	1.08½	1.00	1.00	1.09	1.18½	1.16	1.18½	1.13½	1.17
March	1.04	1.06	1.00	1.00	1.07½	1.16½	1.13	1.16½	1.14	1.15½
April	.96	1.06	1.00	1.00	.98½	1.16	1.06	1.14½	1.05½	1.15⅜
May	.96	.98½	1.00	1.00	.99½	1.09½	1.06½	1.10	1.05⅞	1.08
June	.97	.98	1.00	1.00	1.00	1.08	1.06½	1.08½	1.07¾	1.09¾
July	.98	1.15½	1.00	1.00	1.02	1.24	1.07½	1.24	1.09¼	1.24
August	1.13½	1.18	....	....	1.15½	1.26½	1.23	1.26½	1.23	1.26½
September	1.08	1.18½	....	....	1.09	1.28	1.24½	1.28	1.16½	1.28
October	1.06	1.10	....	....	1.07	1.18	1.14½	1.18¼	1.13½	1.17¼
November	1.07	1.11	....	....	1.08	1.19½	1.15½	1.19½	1.14	1.18⅜
December	1.12	1.16	....	....	1.11	1.26	1.19	1.26	1.18	1.25¾
1905.					(a)			(a)		
January	1.14	1.15	....	....	1.15	1.23	1.21	1.23	1.23	1.24
February	1.14	1.23	....	....	1.15	1.35	1.22	1.23½	1.24½	1.38½
March	1.22	1.26½	....	....	1.23	1.39½	1.35½	1.39½	1.35	1.40¾
April	1.22	1.26	....	....	1.23	1.40	1.37	1.40	1.39	1.42
May	1.22	1.29	....	....	1.25	1.47	1.39	1.47	1.40	1.48
June	1.24	1.29	....	....	1.25	1.47	1.43	1.47	1.47½	1.50
July	1.20	1.30	....	....	1.22½	1.44	1.34	1.44	1.48	1.48
August	1.04	1.30	....	....	1.01	1.35	1.12	1.35	1.30	1.48
September	.90	1.06	1.10	1.10	.92	1.12	.98	1.12	.97¼	1.30
October	.94	.97	1.10	1.10	.92	1.03	.98	1.03	.96¼	1.00
November	.94	.95	1.10	1.10	.93	1.00	.99	1.00	.98¼	1.00⅜
December	.95	1.10	1.10	1.10	.94	1.13	1.00	1.16	.98	1.16
1906.										
January	1.06	1.16	1.10	....	1.06	1.25	1.12½	1.25	1.11½	1.24
February	1.06	1.11	1.10	....	1.06	1.16½	1.10	1.17	1.10¾	1.16¼
March	1.05	1.09	1.10	....	1.04½	1.14	1.11	1.14	1.10⅜	1.17½
April	1.08	1.11	1.10	1.12	1.06	1.16½	1.12	1.18	1.14¼	1.20
May	1.05	1.08	1.12	....	1.06½	1.17	1.12½	1.15¾	1.12½	1.18
June	1.05	1.06½	1.12	....	1.07	1.13	1.11	1.13½	1.11¾	1.14⅞
July	1.03	1.07	1.12	....	1.05	1.12½	1.05	1.12½	1.11¼	1.14½
August	1.02	1.05	1.12	....	1.05½	1.14	1.10	1.14	1.12	1.17¾
September	.98	1.02½	1.12	....	1.03	1.13	1.08	1.14½	1.09¼	1.17½
October	1.03	1.07	1.12	....	1.04½	1.15	1.09½	1.13¼	1.11⅛	1.15⅝
November	1.08	1.17	1.12	....	1.07½	1.22	1.13	1.20½	1.14⅞	1.25⅝
December	1.15	1.19	1.12	....	1.11½	1.23½	1.17½	1.22	1.18⅜	1.22⅛

a No. 1. Northwestern.

Wholesale prices of flaxseed per bushel, 1903–1907—Continued.

Date.	St. Louis.		Cincinnati.		Chicago.		Milwaukee.		Duluth.	
	Prime.		Low.	High.	No. 1.		No. 1. Northwestern.		Low.	High.
	Low.	High.			Low.	High.	Low.	High.		
1907.										
January	$1.17	$1.20	$1.12	....	$1.11½	$1.24	$1.18½	$1.24½	$1.17⅞	$1.22⅜
February	1.18½	1.21	1.12	....	1.16	1.26	1.22½	1.24½	1.20¼	1.23½
March	1.15	1.18½	1.12	....	1.13	1.24	1.19	1.23	1.17¾	1.20¾
April	1.14	1.17½	1.12	....	1.11	1.23	1.16½	1.20	1.16¼	1.21
May	1.16	1.25½	1.12	....	1.14	1.30	1.19	1.26½	1.18½	1.27¾
June	1.24½	1.27	1.12	....	1.24	1.32	1.25	1.31	1.21¾	1.29½
July	1.06	1.10	1.12	....	1.18½	1.26	1.20	1.25	1.16¼	1.23½
August	1.00	1.10	1.12	....	1.07	1.20	1.16	1.20	1.11⅝	1.20
September	1.05	1.14	1.12	....	1.13½	1.28	1.19	1.27	1.21½	1.28¼
October	1.08	1.16	1.12	....	1.11	1.36½	1.16	1.34	1.22¼	1.41½
November	1.00	1.14	1.12	....	.96	1.21½	1.07	1.19	1.06½	1.22
December	1.02	1.10	1.12	....	.99½	1.20	1.07¾	1.14	1.08¾	1.17¼

a No. 1 Northwestern.

RICE.

Rice crop of countries named, 1902–1906.

[Mostly cleaned rice. China, which is omitted, has a roughly-estimated crop of 50,000,000,000 to 60,000,000,000 pounds. Other omitted countries are Afghanistan, Algeria, Brazil, Colombia, Federated Malay States, Madagascar, Persia, Russia (Asiatic), Trinidad and Tobago, Turkey (Asiatic and European) Venezuela, and a few other countries of small production.]

Country.	1902.	1903.	1904.	1905.	1906.
NORTH AMERICA.					
United States:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Contiguous	*a* 319,400,000	*a* 560,800,000	586,000,000	378,000,000	496,000,000
Noncontiguous — Hawaii	*b* 33,400,000	*b* 33,400,000	*b* 33,400,000	*b* 33,400,000	*b* 33,400,000
Total United States (except Philippine Islands)	352,800,000	594,200,000	619,400,000	411,400,000	529,400,000
Central America:					
Guatemala	700,000	1,000,000	1,300,000	*c* 1,300,000	*c* 1,300,000
Honduras	*d* 8,100,000	*d* 8,100,000	*d* 8,100,000	*d* 8,100,000	*d* 8,100,000
Mexico	40,000,000	48,700,000	62,000,000	*c* 62,000,000	*c* 62,000,000
Total North America	401,600,000	652,000,000	690,800,000	482,800,000	600,800,000
SOUTH AMERICA.					
Argentina	*e* 2,000,000	*e* 2,000,000	*e* 2,000,000	*e* 2,000,000	*e* 2,000,000
British Guiana	22,800,000	24,500,000	31,200,000	32,800,000	56,000,000
Dutch Guiana	800,000	1,000,000	1,900,000	2,500,000	*g* 2,500,000
Peru	*e* 60,000,000	*e* 60,000,000	*e* 60,000,000	*e* 60,000,000	*g* 60,000,000
Total South America	85,600,000	87,500,000	95,100,000	97,300,000	120,500,000
EUROPE.					
Austria	200,000	200,000	200,000	300,000	200,000
Bulgaria	*f* 9,900,000	9,800,000	12,200,000	10,800,000	*g* 10,800,000
Italy	668,400,000	761,400,000	760,500,000	676,600,000	728,600,000
Spain	359,800,000	417,100,000	394,600,000	478,800,000	475,400,000
Total Europe	1,038,300,000	1,188,500,000	1,167,500,000	1,166,500,000	1,215,000,000

a Commercial movement.
b Census 1899.
c 1904 figures.
d 1901 figures.
e Estimated average production.
f 1899 figures.
g Figures for previous year.

Rice crop of countries named, 1902–1906—Continued.

Country.	1902.	1903.	1904.	1905.	1906.
ASIA.					
British India: [a]	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
British Provinces	72,688,000,000	68,580,000,000	71,561,000,000	67,916,000,000	67,464,000,000
Native States	[b] 799,000,000	[b] 838,000,000	[b] 764,000,000	[b] 640,000,000	[c] 640,000,000
Total British India	73,487,000,000	69,418,000,000	72,325,000,000	68,556,000,000	68,104,000,000
Ceylon	[b] 550,100,000	[b] 558,800,000	[b] 558,500,000	[b] 547,700,000	[b] 498,100,000
French Indo-China	[d] 5,000,000,000	[d] 5,000,000,000	[d] 5,000,000,000	[d] 5,000,000,000	[d] 5,000,000,000
Japanese Empire:					
Japan	11,533,200,000	14,512,600,000	16,060,600,000	11,920,000,000	14,466,700,000
Formosa	1,762,100,000	2,296,600,000	2,598,100,000	2,719,200,000	[c] 2,719,200,000
Total Japanese Empire	13,295,300,000	16,809,200,000	18,658,700,000	14,639,200,000	17,185,900,000
Java and Madura	5,373,000,000	6,229,000,000	6,431,000,000	6,268,000,000	[c] 6,268,000,000
Korea	[e] 3,300,000,000	[e] 3,300,000,000	[e] 3,200,000,000	[e] 3,200,000,000	[e] 3,200,000,000
Philippine Islands	677,800,000	[f] 677,800,000	[g] 544,000,000	544,000,000	725,000,000
Siam	[e] 3,300,000,000	[e] 2,800,000,000	[e] 3,400,000,000	[e] 3,300,000,000	[e] 3,900,000,000
Straits Settlements	[b] 92,000,000	[b] 95,000,000	[b] 95,000,000	[b] 93,000,000	[c] 93,000,000
Total Asia	105,075,200,000	104,887,800,000	110,212,200,000	102,147,900,000	104,974,000,000
AFRICA.					
British Central Africa	[h] 2,200,000	[h] 2,200,000	2,200,000	1,800,000	[c] 1,800,000
Egypt	[d] 20,000,000	[d] 20,000,000	[d] 20,000,000	[d] 20,000,000	[d] 20,000,000
Total Africa	22,200,000	22,200,000	22,200,000	21,800,000	21,800,000
OCEANIA.					
Fiji	[b] 3,500,000	[b] 3,000,000	[b] 3,000,000	[b] 2,800,000	[b] 2,800,000
Grand total	106,626,400,000	106,841,000,000	112,190,800,000	103,919,100,000	106,943,900,000

[a] Figures for British India refer to crop years beginning in the spring of the calendar years mentioned in this table.
[b] Estimated from official returns of acreage.
[c] Figures for previous year.
[d] Estimated average production.
[e] Estimated from official returns of exports of this country, and from per capita consumption of rice in Japan, including food, seed, and waste, but not including rice used for *sake*, for 1904 (270 pounds per annum).
[f] Census 1902.
[g] 1905 figures.
[h] 1904 figures.

Acreage, production, and value of rice in the United States, 1904–1907.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1904	662,006	31.9	21,096,038	65.8	13,891,523
1905	460,198	28.1	12,933,436	95.0	12,285,834
1906	575,014	31.1	17,854,768	90.3	16,121,298
1907	627,300	29.9	18,738,000	85.8	16,081,000

Condition of the rice crop in the United States, monthly, 1903–1907.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1903	93.5	92.0	93.6	90.6	1906	82.9	83.1	86.8	87.2
1904	88.2	90.2	89.7	87.3	1907	88.7	88.6	87.0	88.7
1905	88.0	92.9	92.2	89.3					

Acreage, production, and value of rice in the United States in 1907, by States.

State.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
North Carolina	1,000	23.0	23,000	91	21,000
South Carolina	19,100	27.0	516,000	107	552,000
Georgia	2,400	34.0	81,000	105	85,000
Florida	2,300	30.0	69,000	110	76,000
Alabama	1,400	25.0	35,000	95	33,000
Mississippi	1,100	22.0	24,000	90	22,000
Louisiana	310,000	28.0	8,680,000	85	7,378,000
Texas	284,000	32.0	9,088,000	85	7,725,000
Arkansas	6,000	37.0	222,000	85	189,000
United States	627,300	29.9	18,738,000	85.8	16,081,000

Wholesale prices of rice per pound, 1903–1907.

Date.	New York.		Cincinnati.		Lake Charles.		New Orleans.		Houston.	
	Domestic (good).		Prime.		Rough.[a]		Honduras, cleaned.		(Head rice) cleaned.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Dolls.*	*Dolls.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	4 7/8	5	4 3/8	5 1/4	1.75	3.40	1 1/4	6 1/2	4 1/2	5 7/8
February	5	5	4 3/8	5 1/4	1.75	3.40	1 3/4	6 1/4	4 1/2	6
March	5 1/8	5 1/4	4 3/8	5 1/4	1.75	3.40	1 3/4	6 3/8	4 1/2	6
April	5 1/4	5 1/4	4 3/8	5 1/4	......	......	1 7/8	6 1/2	4 1/2	5 3/4
May	5 1/4	5 1/4	4 3/8	5 1/4	......	......	2 1/8	6 1/8	4 1/2	5 3/4
June	5 1/4	5 1/4	4 3/8	5 1/4	......	......	2 1/4	6 1/8	4 1/2	6
July	5 1/4	5 1/4	4 3/8	5 1/4	......	......	2 1/2	6 1/2	4 3/4	6 1/8
August	5 1/8	5 1/4	4 3/8	5 1/4	......	......	2 1/4	6	4 3/4	6 1/8
September	4 7/8	5 1/8	4 3/8	5 1/4	2.00	3.60	2 3/8	5 5/8	4 3/4	6 1/4
October	4 1/2	4 7/8	4 3/8	5 1/2	1.75	3.60	1 5/8	5 5/8	4 3/4	6 1/4
November	4 1/4	4 1/2	4 5/8	5 1/2	1.60	3.25	1 1/8	5 1/2	4 1/4	5 1/2
December	4 1/4	4 1/4	4 5/8	5 1/2	1.50	3.00	1 1/4	5	4	5
1904.										
January	4 1/4	4 1/4	4 3/4	5 1/4	1.50	3.00	1 1/2	4 7/8	3 1/2	4 3/4
February	4	4	4 3/4	5 1/4	1.50	2.75	1 1/2	4 5/8	3 1/2	4 5/8
March	4	4	4 1/2	5	1.25	2.50	1 1/8	4 3/4	3 1/2	4 1/2
April	4	4	4 1/4	4 3/4	1.25	2.25	1 1/8	4 1/4	3 1/4	4 1/4
May	3 3/4	4	4 1/4	4 3/4	1.25	2.00	1 3/8	4 3/8	3 1/4	4
June	3 5/8	3 3/4	4 1/4	4 3/4	1.25	2.00	1 7/10	4	3 1/4	4
July	3 5/8	3 5/8	3 3/4	4 1/4	1.25	2.00	1 2/3	4 1/4	3	4
August	3 3/8	3 5/8	3 3/4	4 1/4	1.25	2.00	1 5/8	5 1/4	3	4
September	3 3/8	3 3/8	3 3/4	4 1/4	1.25	2.00	1 1/4	4 3/4	3	4
October	3 3/8	3 3/8	3 3/4	4 1/4	1.10	2.00	1 1/4	5	3	3 7/8
November	3 3/8	3 3/8	3 3/4	4 1/4	1.10	2.00	1 1/8	5 1/8	3	3 3/4
December	3 3/8	3 3/8	3 3/4	4 1/4	1.00	2.00	1 1/16	5 1/4	3	3 3/4
1905.										
January	3 3/8	3 3/8	3 3/4	4 1/4	1.00	2.00	1 1/8	5 1/8	3	3 3/4
February	3 3/8	3 3/8	3 3/4	4 1/4	1.00	2.00	1	4 3/4	3	3 3/4
March	3 3/8	3 3/8	3	4	1.00	2.35	1 3/16	4 5/8	3	3 3/4
April	3 3/8	3 3/8	3	4	1.00	2.25	1 1/8	4 1/8	3	3 1/2
May	3 3/8	3 3/8	3 1/2	4 1/2	1.00	2.50	1 3/8	4 1/2	3	3 1/2
June	3 1/2	3 3/4	4	5	1.00	2.50	2 1/8	5	3	3 3/4
July	3 3/4	3 3/4	4	5	1.00	2.50	2 1/8	4 3/4	3	4
August	3 3/4	3 3/4	4	5	1.25	3.00	1 3/4	5 1/4	3	4 1/4
September	3 3/4	4	4	5	2.00	3.25	1 3/4	5 5/8	3	4 1/2
October	4 1/8	4 1/8	4	5	2.00	3.25	2	5 3/4	3	4 3/4
November	4 1/8	4 1/8	4 1/2	5 1/4	2.00	3.75	2 3/8	5 3/8	3	5
December	4 1/2	4 1/2	4 1/2	5 1/4	2.00	3.85	2	5 1/8	3 1/2	5
1906.										
January	5	5 1/4	4 1/2	5 1/4	2.25	3.85	2 5/8	5 3/8	4	5 1/2
February	5	5 1/4	4 1/2	5 1/4	2.25	3.85	2 3/8	5 1/2	4	5 1/2
March	5	5	4 1/2	5 1/4	2.25	3.85	2	5 1/2	4	5 1/2
April	4 7/8	5	4 1/2	5 1/2	......	......	2 1/2	5 3/4	3 1/2	5
May	4 7/8	5	4 3/4	5 1/4	......	......	1 1/8	6	3 1/2	5
June	5	5 1/4	4 3/4	5 1/2	......	......	2 1/8	5 3/4	3 3/4	5 1/4
July	5 1/4	5 1/2	4 3/4	5 1/2	......	......	2 1/8	5 3/4	3 3/4	5 1/4
August	5 1/4	5 1/4	4 3/4	5 1/2	2.50	3.85	2	6 1/2	3 3/4	5 1/4
September	5 1/4	5 1/4	4 3/4	5 1/2	2.50	3.85	2 3/8	5 5/8	3 3/4	5 1/4
October	5 3/8	5 1/2	4 3/4	5 1/2	2.25	3.85	2 1/8	5 3/4	4 1/4	5 3/4
November	5 1/4	5 3/8	4 3/4	5 1/2	2.25	3.50	2	5 5/8	4 1/2	5 3/4
December	5	5 1/4	4 3/4	5 1/2	2.00	3.25	1 3/4	5 3/4	4	5 1/4

[a] Per barrel of 162 pounds.

Wholesale prices of rice per pound, 1903–1907—Continued.

Date.	New York. Domestic (good).		Cincinnati. Prime.		Lake Charles. Rough.[a]		New Orleans. Honduras, cleaned.		Houston. Head rice, cleaned.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1907.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Dolls.*	*Dolls.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	......	......	4¾	5½	2.00	3.50	1¾	6	5	5⅛
February	......	......	4¾	5½	2.00	3.50	1¾	6	5⅛	5¼
March	......	......	4¾	5½	2.25	3.50	1½	5½	5⅛	5¼
April	......	......	4¾	5½	1.75	3.00	1½	5¾	5⅛	5¼
May	......	......	4¾	5¾	......	......	1⅝	6	5⅝	5¾
June	......	......	5	6	......	......	2⅛	6⅛	6	6
July	......	......	5	6	......	......	2⅛	6½	6⅛	6¼
August	......	......	5	6	......	......	2	6½	6⅛	6¼
September	......	......	5	6	2.35	3.60	2¼	6 3/16	5⅝	5¾
October	......	......	4¾	6	2.35	4.10	2	6⅛	5⅜	5½
November	......	......	4¾	5¾	2.60	3.90	2	5⅞	4⅞	5⅛
December	......	......	4¾	5¾	2.00	3.90	1⅞	6	4⅞	5⅛

[a] Per barrel of 162 pounds.

International trade in rice, 1902–1906.[a]

[Mostly cleaned rice.]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Belgium	Jan. 1	39,117,023	49,161,919	60,794,820	41,923,262	73,215,968
British India	Apr. 1	5,311,239,248	5,029,409,504	5,528,868,240	4,801,937,168	4,317,224,576
Dutch East Indies	Jan. 1	96,676,733	85,391,653	105,792,310	98,247,103	99,339,522
Formosa	Jan. 1	133,500,436	184,676,337	197,154,447	221,561,825	[b] 221,561,825
France	Jan. 1	55,203,697	58,795,657	52,017,359	54,089,610	69,981,556
French Indo-China	Jan. 1	2,459,480,031	1,490,364,515	2,128,799,044	1,369,646,421	[b] 1,369,646,422
Germany [c]	Jan. 1	227,755,531	227,661,173	181,073,762	222,773,526	300,225,203
Netherlands	Jan. 1	246,932,274	256,578,864	298,075,104	282,611,808	295,873,665
Penang	Jan. 1	315,152,667	229,739,333	154,148,400	213,530,667	[b] 213,530,667
Siam	Jan. 1	1,785,261,733	1,310,950,400	1,892,988,933	1,835,880,400	2,058,961,467
Singapore	Jan. 1	819,742,133	687,836,400	702,571,733	672,031,467	[b] 672,031,467
Other countries	....	521,922,000	587,795,000	585,125,000	610,047,779	[d] 642,176,502
Total	....	12,011,983,506	10,198,360,755	11,887,409,152	10,424,281,036	10,333,768,840

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	171,421,706	162,532,230	189,403,926	156,519,564	219,120,246
Belgium	Jan. 1	117,746,936	129,772,365	140,564,807	132,971,397	149,701,442
Brazil	Jan. 1	222,632,829	162,235,816	134,043,452	129,413,871	88,821,786
British India	Apr. 1	275,329,488	309,342,432	307,257,440	371,676,368	239,077,776
Ceylon	Jan. 1	641,730,096	687,640,128	699,259,008	714,172,144	721,218,064
China	Jan. 1	1,297,420,533	373,585,867	447,577,333	297,055,467	624,860,267
Cuba	Jan. 1	169,841,863	149,574,339	196,439,462	214,934,597	192,766,374
Dutch East Indies	Jan. 1	819,659,758	440,099,790	678,382,754	661,108,710	761,367,696
Egypt	Jan. 1	89,927,953	84,159,745	104,163,198	89,979,896	101,814,530
France	Jan. 1	404,010,628	210,890,911	412,469,802	375,080,970	387,572,724
Germany [c]	Jan. 1	806,702,495	642,295,455	602,833,603	627,278,011	714,477,866
Japan	Jan. 1	601,209,600	1,621,654,000	1,964,238,000	1,546,121,733	813,478,133
Mauritius	Jan. 1	138,228,382	141,143,562	159,853,482	114,012,106	134,012,761
Netherlands	Jan. 1	495,572,167	495,788,960	523,497,732	493,955,916	561,916,463
Penang	Jan. 1	162,345,333	153,461,067	252,778,533	263,046,133	[b] 263,046,133
Philippine Islands	Jan. 1	639,460,077	737,083,174	585,880,567	483,411,974	280,101,412
Russia	Jan. 1	138,453,658	162,267,811	157,232,062	177,144,824	[d] 163,110,829
Singapore	Jan. 1	1,040,446,667	849,067,467	900,587,600	816,150,667	[b] 816,150,667
United Kingdom	Jan. 1	762,437,536	607,701,584	620,591,664	685,939,744	768,403,216
United States	July 1	169,656,284	154,221,772	106,483,515	166,547,957	209,603,190
Other countries	....	970,693,000	1,074,569,000	1,206,744,000	1,205,744,166	[d] 1,672,456,153
Total	....	10,134,926,989	9,349,087,475	10,390,281,940	9,722,266,215	9,883,077,728

[a] See "General note," p. 615.
[b] Year preceding.
[c] Not including free ports prior to March 1, 1906.
[d] Preliminary.

HOPS.

Hop crop of countries named, 1903–1907.

[Excluding Canada, for which the census of 1901 shows a production during the preceding year of 1,004,216 pounds. Other omitted countries are of very small production.]

Country.	1903.	1904.	1905.	1906.	1907.
NORTH AMERICA.					
United States: [a]	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
New York	9,000,000	11,880,000	9,360,000	12,006,000	[b] 8,000,000
California	10,920,000	12,285,000	14,235,000	15,520,000	[b] 16,000,000
Oregon	17,550,000	17,550,000	22,191,000	23,985,000	[b] 25,000,000
Washington	6,825,000	7,410,000	9,750,000	8,775,000	[b] 8,000,000
Total United States	44,295,000	49,125,000	55,536,000	60,286,000	[b] 57,000,000
EUROPE.					
Austria-Hungary:					
Austria	9,010,000	19,598,000	39,305,000	15,012,000	29,975,000
Hungary	808,000	592,000	775,000	1,647,000	[c] 3,136,000
Total Austria-Hungary	9,818,000	20,190,000	40,080,000	16,659,000	33,111,000
Belgium	4,786,000	9,830,000	11,281,000	7,705,000	[c] 5,376,000
France	7,311,000	7,753,000	11,065,000	9,156,000	[c] 6,160,000
Germany	46,562,000	49,136,000	64,500,000	46,384,000	53,255,000
Netherlands	100,000	[d] 158,000	[d] 158,000	[d] 158,000	[d] 158,000
Russia	12,500,000	8,700,000	14,500,000	8,775,000	12,639,000
United Kingdom: England	47,160,000	31,621,000	77,946,000	27,517,000	41,902,000
Total Europe	128,237,000	127,388,000	219,530,000	116,354,000	152,601,000
AUSTRALASIA.					
Australia:					
Victoria	176,000	274,000	162,000	213,000	312,000
Tasmania	809,000	865,000	912,000	[e] 809,000	[e] 809,000
New Zealand	940,000	1,150,000	1,120,000	[e] 1,035,000	[e] 1,035,000
Total Australasia	1,925,000	2,289,000	2,194,000	2,057,000	2,156,000
Grand total	174,457,000	178,802,000	277,260,000	178,697,000	211,757,000

[a] Estimate based upon reports to California Fruit Grower and American Agriculturist.
[b] Preliminary estimate.
[c] Estimate of Gütermann Sons, Saaz, Bohemia.
[d] Average, 1900–1903.
[e] Average, 1902–1905.

Wholesale prices of hops per pound, 1903–1907.

Date.	New York.		Cincinnati.		Chicago.	
	Choice State.		Choice.		Pacific coast, good to choice.	
	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	35	37	29	29	27	31
February	33	37	29	29	27	31
March	30	35	29½	29½	25	29
April	23	30	25	25	20	25
May	23	24	25	25	20	24
June	22½	24	24	24	22	24
July	20½	23½	24	24	19	22
August	20½	26	24	24	21	25
September	24½	30	25	25	26	28
October	30	33	26	26	20	27
November	30	32	26	26	24	26
December	30	35	27	27	24	27
1904.						
January	34	37	28	31	28½	34
February	36	38	31	34	30	35
March	34	38	30	32	32	34
April	33	36	30	32	30	34
May	33	35	29	31	30	35
June	32	35	29	30	30	32
July	32	34	29	30	30	31
August	32	35	29	29	30	34
September	33	37	29	31	28½	31
October	35	41	31	36	30	35½
November	36	41	36	37	32	37
December	35	38	34	36	33	37
1905.						
January	34	37	33	33	30	34
February	30	36	31½	31½	26	30
March	27	31	30	30	26	30
April	27	29	29	29	26	29
May	27	29	29	29	26	28
June	26	29	28	28	21	25
July	25	27	24	24	20	24
August	22	26	22	22	18	23
September	20	23	18½	18½	15	18
October	19	23	17	17	10	15
November	13	22	14½	14½	12	15
December	16	21	13½	13½	10	14
1906.						
January	15	19	13	14½	12	14
February	14	17	13	14½	10	14
March	13	16	12	14	9	14
April	12	15	12	17	10	17
May	11	15	12	15	9	15
June	11	14	12	15	9	14
July	12	17	12	17½	10	17
August	15	17	17	18	12	18
September	15	17	14	18	12	22
October	22	25	17	18	14	18
November	23	25	17½	18½	13	18
December	21	24	17½	18½	12	18
1907.			Prime.		Prime to choice.	
January	21	23	16½	....	12	18
February	21	23	16½	....	12	17
March	21	23	14½	....	10	15
April	15	20	13	....	8	12
May	15	16	13	....	10	13
June	15	16	14	....	8	12
July	15	16	13½	....	7	11
August	14	16	12½	....	6	9
September	12	15	12	....	10	13
October	12	18	12	....	9	13
November	16	18	12	....	8	12
December	16	17	12	....	8	11

International trade in hops, 1902–1907.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Austria-Hungary	Jan. 1	11,497,765	5,900,230	10,037,424	18,777,206	12,320,310
Belgium	Jan. 1	3,659,302	3,438,251	9,665,294	2,582,318	3,178,692
France	Jan. 1	541,964	442,521	784,610	606,364	382,722
Germany [b]	Jan. 1	22,702,756	22,003,671	24,358,207	22,855,096	26,767,198
Netherlands	Jan. 1	1,920,942	1,235,779	2,104,063	1,256,989	1,534,058
New Zealand	Jan. 1	482,832	433,776	644,336	369,712	490,448
Russia	Jan. 1	1,400,129	1,744,212	1,117,294	1,140,117	[c]1,877,866
United Kingdom	Jan. 1	1,767,920	2,499,504	1,554,336	1,820,448	1,300,096
United States	July 1	7,794,705	10,985,988	14,858,612	13,026,904	16,809,534
Other countries		78,206	107,526	136,805	79,732	[c]77,912
Total		51,846,521	48,791,458	65,260,981	62,514,886	64,738,836

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Australia	Jan. 1	1,140,388	975,658	913,830	1,279,362	1,412,569
Austria-Hungary	Jan. 1	1,025,811	4,481,556	2,109,162	1,187,189	1,346,363
Belgium	Jan. 1	4,427,816	6,478,233	4,826,301	6,617,221	5,431,355
British India	Apr. 1	495,824	517,328	469,728	448,224	342,608
Canada	July 1	623,403	781,822	737,054	1,020,265	[c]1,004,409
Cape of Good Hope	Jan. 1	848,960	555,856	487,424	308,112	348,432
Denmark	Jan. 1	1,300,617	1,401,037	1,359,149	1,378,660	1,297,861
France	Jan. 1	4,312,256	5,045,432	4,428,343	3,879,328	4,386,095
Germany [b]	Jan. 1	6,004,068	2,992,995	5,346,208	9,047,989	4,865,380
Netherlands	Jan. 1	2,996,258	2,742,861	4,020,148	3,368,742	3,497,750
Russia	Jan. 1	945,289	807,085	1,363,547	1,199,162	[c]1,263,948
Sweden	Jan. 1	1,461,343	1,436,809	1,298,174	1,662,563	1,275,477
Switzerland	Jan. 1	1,003,764	1,012,142	1,168,891	1,347,685	1,087,540
United Kingdom	Jan. 1	20,593,888	11,876,032	34,437,312	11,147,584	25,702,992
United States	July 1	6,012,510	2,758,163	4,339,379	10,113,989	6,211,893
Other countries		2,920,344	3,247,109	2,453,778	2,948,445	[c]3,399,590
Total		56,112,539	47,110,118	69,758,428	56,954,520	62,874,262

[a] See "General note," p. 615.
[b] Not including free ports prior to March 1, 1906.
[c] Preliminary.

SUGAR.

Sugar production of countries named, 1903–1904 to 1907–1908.

[European beet sugar, as estimated by Licht; United States beet sugar, from reports of Department of Agriculture on the Progress of the Beet-Sugar Industry in the United States; production of British India (except 1907–8) and of Formosa and Natal prior to 1905–6 from official statistics; other data, from Willett & Gray. The estimates of Willett & Gray do not include the production of China, and some other less important sugar-producing countries.]

Country.	1903–4.	1904–5.	1905–6.	1906–7.	1907–8.
CANE SUGAR.					
NORTH AMERICA.					
United States:					
Contiguous—	*Tons.*[a]	*Tons.*[a]	*Tons.*[a]	*Tons.*[a]	*Tons.*[a]
Louisiana	228,477	335,000	330,000	230,000	335,000
Texas	19,800	15,000	12,000	13,000	12,000
Noncontiguous—					
Hawaii	328,103	380,576	383,225	392,871	420,000
Porto Rico	130,000	145,000	213,000	210,000	217,000
Total United States (except Philippine Islands)	706,380	875,576	938,225	845,871	984,000
Central America:					
Costa Rica	3,275	2,305	1,377	2,000	2,000
Guatemala	7,640	7,640	6,795	7,000	7,000
Nicaragua	4,235	4,235	4,400	4,000	4,000
Salvador	6,300	5,588	5,944	6,000	6,000
Mexico	107,547	107,038	107,529	108,000	115,000

[a] Tons of 2,240 pounds, except beet sugar in Europe, which is shown in metric tons of 2,204.622 pounds.

Sugar production of countries named, 1903-1904 to 1907-1908—Continued.

Country.	1903-4.	1904-5.	1905-6.	1906-7.	1907-8.
West Indies:					
British—	*Tons.*[a]	*Tons.*[a]	*Tons.*[a]	*Tons.*[a]	*Tons.*[a]
Antigua and St. Kitts	19,000	24,000	24,000	24,000	24,000
Barbados[a]	58,081	41,600	49,864	33,000	40,000
Jamaica[a]	14,255	11,251	12,523	15,000	15,000
Trinidad[a]	44,058	31,000	56,455	45,631	50,000
Cuba	1,040,228	1,163,258	1,178,749	1,427,673	1,200,000
Danish—St. Croix	13,000	11,000	13,000	13,000	13,000
French—					
Guadeloupe	35,976	36,000	36,000	36,000	36,000
Martinique[a]	23,936	29,986	42,231	40,000	40,000
Haiti and Santo Domingo	47,000	47,000	55,090	60,000	60,000
Lesser Antilles	13,000	13,000	13,000	13,000	13,000
Total North America	2,143,911	2,410,477	2,545,182	2,680,175	2,609,000
SOUTH AMERICA.					
Argentina	142,895	128,104	137,308	118,817	115,000
Brazil	197,000	195,000	275,000	215,000	200,000
British Guiana[b]	113,282	101,278	121,693	120,334	105,000
Dutch Guiana	13,000	13,000	13,000	13,000	13,000
Peru	131,957	150,000	150,000	140,000	150,000
Venezuela	3,000	3,000	3,000	3,000	3,000
Total South America	601,134	590,382	700,001	610,151	586,000
EUROPE.					
Spain	28,000	18,592	15,722	16,400	11,000
ASIA.					
British India[b]	1,871,986	2,169,000	1,725,500	2,223,400	2,100,000
Formosa	35,124	48,897	64,190	75,000	90,000
Java	885,561	1,008,900	990,994	1,011,546	1,156,477
Philippine Islands	84,000	106,875	145,525	145,500	135,000
Total Asia	2,876,671	3,333,672	2,926,209	3,455,446	3,481,477
AFRICA.					
Egypt	60,000	60,000	65,000	60,000	60,000
Mauritius	220,589	142,101	188,364	220,000	135,000
Natal	34,041	19,239	26,603	34,000	40,000
Reunion	41,117	30,000	38,000	35,000	35,000
Total Africa	355,747	251,340	317,967	349,000	270,000
OCEANIA.					
Australia:					
Queensland	91,828	147,688	170,000	182,000	183,000
New South Wales	21,500	21,525	20,000	24,000	25,000
Fiji[c]	50,000	47,000	40,000	43,000	68,000
Total Oceania	163,328	216,213	230,000	249,000	276,000
Total cane-sugar production	6,168,791	6,820,676	6,735,081	7,360,172	7,233,477
BEET SUGAR.					
NORTH AMERICA.					
United States	214,825	216,173	279,393	431,796	413,954
Canada	6,710	8,034	11,419	11,367	7,943
Total North America	221,535	224,207	290,812	443,163	421,897
EUROPE.					
Austria-Hungary	1,167,959	889,373	1,509,870	1,344,000	1,460,000
Belgium	209,811	176,466	328,770	283,000	235,000
France	804,308	622,422	1,089,684	756,000	725,000
Germany	1,927,681	1,598,164	2,415,136	2,238,000	2,135,000
Netherlands	123,551	136,551	207,189	181,000	175,000
Russia	1,206,907	953,626	968,000	1,470,000	1,410,000
Other countries	441,116	332,098	415,000	445,000	435,000
Total Europe	5,881,333	4,708,700	6,933,649	6,717,000	6,575,000
Total beet-sugar production	6,102,868	4,932,907	7,224,461	7,160,163	6,996,897
Total cane and beet sugar	12,271,659	11,753,583	13,959,542	14,520,335	14,230,374

[a] Tons of 2,240 pounds, except beet sugar in Europe, which is shown in metric tons of 2,204.622 pounds.
[b] Exports.
[c] Official estimates for such parts of British India as return statistics of production.

Sugar-beet acreage and beet-sugar production in the United States, 1901 to 1907.

[From reports of Department of Agriculture on Progress of the Beet-Sugar Industry in the United States. Full explanations of the table are given in the report for 1907.]

State and year.	Factories in operation.	Area harvested.	Average yield of beets per acre.	Beets worked.	Sugar manufactured.	Estimated average extraction of sugar.	Average sugar in beets.	Average purity coefficient of beets.	Average length of campaign.
1907.									
	No.	*Acres.*	*Tons.*[a]	*Tons.*[a]	*Pounds.*	*Per ct.*	*Per ct.*		*Days.*
California	8	47,387	10.23	484,816	146,045,500	15.06	17.9	85.1	73
Colorado	16	127,678	11.93	1,523,303	338,573,000	11.11	15.3	81.5	127
Idaho	4	25,938	9.41	244,080	75,928,200	15.55	17.8	88.3	88
Michigan	16	88,334	7.98	696,785	169,452,000	12.16	15.1	84.7	70
Utah	5	28,663	12.32	353,159	88,973,500	12.60	16.3	86.0	116
Wisconsin	4	11,837	10.37	122,800	30,320,000	12.35	15.1	85.6	61
Ten States having one factory each.	10	41,147	8.33	342,928	77,964,230	11.37	15.1	82.3	70
Totals and averages	63	370,984	10.16	3,767,871	927,256,430	12.30	15.8	83.6	89
1906	63	376,074	11.26	4,236,112	967,224,000	11.42	14.9	82.2	105
1905	52	307,364	8.67	2,665,913	625,841,228	11.74	15.3	83.0	77
1904	48	197,784	10.47	2,071,539	484,226,430	11.69	15.3	83.1	78
1903	49	242,576	8.56	2,076,494	481,209,087	11.59	15.1	(b)	75
1902	41	216,400	8.76	1,895,812	436,811,685	11.52	14.6	83.3	94
1901	36	175,083	9.63	1,685,689	369,211,733	10.95	14.8	82.2	88

[a] Short tons—2,000 ounds. [b] No data.

Production of sugar in the United States and its possessions, 1854–55 to 1907–8.

[Census data, as far as available, are given in *italics*. Beet-sugar production for 1897–98 from Special Report of Department of Agriculture; for 1901–2 and later years from Progress of the Beet-Sugar Industry in the United States; for other years from Willett & Gray. Production of cane sugar in Louisiana beginning with 1904–5, and in Texas beginning with 1903–4, from Willett & Gray; earlier statistics for Louisiana and other Southern States from Bouchereau, in part taken directly from his reports and in part from the Statistical Abstract. Porto Rican production of cane sugar for 1854–55 to 1884–85 from Rueb & Co.; for later years from Willett & Gray. Statistics for Hawaii, 1874–75 to 1880–81, represent exports, from Bureau of Statistics Bul. 30; for 1881–82 to 1884–85 from Rueb & Co.; for later years from Willett & Gray. Statistics for Philippine Islands for 1854–55 to 1857–58, 1859–60 to 1866–67, 1872–73 to 1894–95 represent exports as officially returned, taken from the Census of the Philippine Islands, 1903; for 1858–59, 1867–68 to 1871–72 from Foreign Markets Bul. 14, representing commercial estimates of exports; subsequently from Willett & Gray, the statistics for 1895–96 to 1903–4 representing exports, later years, production. Tons of 2,240 pounds are used throughout.]

Year.	Beet sugar.	Cane sugar.					Total.
		Louisiana.	Other Southern States.	Porto Rico.	Hawaii.	Philippine Islands.	
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1854–55		171,976	13,169	58,377		35,008	278,530
1855–56		113,647	9,821	82,000		47,397	252,865
1856–57		36,327	2,673	85,000		36,066	160,066
1857–58		137,351	6,385	69,444		26,858	240,038
1858–59		185,177	8,169	58,000		50,095	301,441
1859–60		113,891	5,149	57,000		49,013	225,053
1860–61		118,332	4,313	67,000		45,316	234,961
1861–62		235,858	5,138	68,000		60,957	369,953
1862–63		43,232	2,768	63,000		51,240	160,240
1863–64		37,723	250	61,590		44,325	144,288
1864–65		4,821	179	63,375		46,092	114,867
1865–66		8,884	348	64,417		40,636	114,685
1866–67		19,152	3,348	68,229		55,195	146,324
1867–68	[a] 400	18,482	4,518	73,935		74,081	171,416
1868–69		42,434	2,567	81,500		68,818	195,719
1869–70		44,399	2,402	102,110		78,214	227,525
1870–71		75,392	4,208	103,304		87,465	270,769
1871–72		65,583	4,217	89,559		95,526	255,285
1872–73	500	55,958	4,235	87,639		83,865	232,197
1873–74	700	46,090	2,410	71,755		99,770	220,725

[a] Mean annual production; quantity varied from year to year between 300 and 500 tons.

Production of sugar in the United States and its possessions, 1854–55 to 1907–8—Cont'd.

Year.	Beet sugar.	Cane sugar. Louisiana.	Cane sugar. Other Southern States.	Cane sugar. Porto Rico.	Cane sugar. Hawaii.	Cane sugar. Philippine Islands.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1874–75		60,047	3,454	72,128	11,197	126,089	273,015
1875–76	*a* 100	72,954	4,046	70,016	11,639	128,485	287,240
1876–77		85,122	3,879	62,340	11,418	121,052	283,911
1877–78		65,671	5,330	84,347	17,157	120,096	292,701
1878–79	200	106,908	5,090	76,411	21,884	129,777	340,270
1879–80	1,200	88,822	3,980	57,057	28,386	178,329	357,774
1880–81	500	121,867	5,500	61,715	41,870	205,508	436,960
1881–82	*a* 500	71,373	5,000	80,066	50,972	148,047	355,958
1882–83		135,297	7,000	77,632	51,705	193,726	465,860
1883–84	535	128,443	6,800	98,665	63,948	120,199	418,590
1884–85	953	94,376	6,500	70,000	76,496	200,997	449,322
1885–86	600	127,958	7,200	64,000	96,500	182,019	478,277
1886–87	800	80,859	4,535	86,000	95,000	169,040	436,234
1887–88	255	157,971	9,843	60,000	100,000	158,445	486,514
1888–89	1,861	144,878	9,031	62,000	120,000	224,861	562,631
1889–90	2,203	124,772	8,159	55,000	120,000	142,554	452,688
1889–90 (*Census*)		*130,418*	*4,089*				
1890–91	3,459	215,844	6,107	50,000	125,000	136,035	536,445
1891–92	5,356	160,937	4,500	70,000	115,598	248,806	605,197
1892–93	12,018	217,525	5,000	50,090	140,000	257,392	681,935
1893–94	19,950	265,836	6,854	60,000	136,689	207,319	696,648
1894–95	20,092	317,334	8,288	52,500	131,698	336,076	865,988
1895–96	29,220	237,721	4,973	50,000	201,632	230,000	753,546
1896–97	37,536	282,009	5,570	58,000	224,218	202,000	809,333
1897–98	40,398	310,447	5,737	54,000	204,833	178,000	793,415
1898–99	32,471	245,512	3,442	53,826	252,507	93,000	680,758
1898–99 (*Census*)		*248,658*	*b 5,266*				
1899–1900	72,944	147,164	2,027	35,000	258,521	62,785	578,441
1899–1900 (*Census*)	*72,972*	*142,485*	*1,510*		*248,008*		
1900–1901	76,859	270,338	2,891	80,000	321,461	55,400	806,949
1901–2	164,827	321,676	3,614	85,000	317,509	78,637	971,263
1902–3	194,782	329,226	3,722	85,000	391,062	90,000	1,093,792
1902 (*Census*)						*177,371*	
1903–4	214,825	228,477	*b* 19,800	130,000	328,103	84,000	1,005,205
1904–5	216,173	335,000	*b* 15,000	145,000	380,576	106,875	1,198,624
1904–5 (*Census*)	*226,715*						
1905–6	279,393	330,000	*b* 12,000	213,000	383,225	145,525	1,363,143
1906–7	431,796	230,000	*b* 13,000	210,000	392,871	145,500	1,423,167
1907–8	413,954	335,000	*b* 12,000	217,000	420,000	135,000	1,532,954

a Production uncertain; not exceeding quantity stated. *b* Texas.

International trade in sugar, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Austria-Hungary	Jan. 1	1,500,882,186	1,564,437,691	1,125,102,823	1,265,791,878	1,631,529,629
Argentina	Jan. 1	91,919,510	66,888,231	40,368,833	4,847,964	233,690
Belgium	Jan. 1	296,287,771	257,180,695	406,944,665	304,193,682	462,976,753
Brazil	Jan. 1	301,498,062	48,256,967	17,331,526	83,216,786	187,278,992
British Guiana	Apr. 1	280,284,480	282,125,760	239,043,840	261,072,000	257,490,912
British India	Apr. 1	55,645,520	57,474,592	57,211,504	64,546,944	58,660,896
China	Jan. 1	89,945,867	39,890,000	48,787,467	69,228,800	23,106,000
Cuba	Jan. 1	1,781,561,643	2,118,279,646	2,459,166,945	2,412,915,391	2,643,700,975
Dutch East Indies	Jan. 1	1,904,371,591	1,907,867,945	2,318,243,282	2,314,655,085	2,197,208,868
Egypt	Jan. 1	98,521,149	86,469,803	50,620,531	67,821,106	10,495,854
Formosa	Jan. 1	100,873,254	54,128,545	79,518,816	93,930,689	*b* 93,930,689
France	Jan. 1	804,993,320	469,129,814	636,360,461	658,062,149	617,793,487
Germany *c*	Jan. 1	2,367,596,256	2,249,141,034	1,720,574,091	1,636,803,746	2,671,881,051
Mauritius	Jan. 1	331,172,713	375,505,049	435,923,559	361,987,596	410,917,817
Netherlands	Jan. 1	310,694,069	287,238,939	403,476,558	215,001,603	356,157,015
Peru	Jan. 1	258,738,790	281,482,880	290,916,853	295,935,805	*b* 295,935,805
Philippine Islands	Jan. 1	217,486,869	188,114,307	191,917,567	239,196,273	285,394,747
Reunion	Jan. 1	50,077,330	107,862,584	80,432,029	41,433,135	*b* 41,433,135
Russia	Jan. 1	288,610,934	540,418,988	398,854,898	220,925,074	*d* 206,854,118
Trinidad and Tobago	Apr. 1	105,861,392	90,460,944	106,573,936	81,179,056	100,809,856
Other countries		617,792,000	609,680,000	569,646,000	901,932,101	*d* 952,547,723
Total		11,854,814,706	11,682,034,414	11,677,016,184	11,594,676,863	13,506,338,012

a See "General note," p. 615.
b Year preceding.
c Not including free ports prior to March 1, 1906.
d Preliminary.

International trade in sugar, 1902–1906—Continued.

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Australia	Jan. 1	208,551,056	205,026,640	85,198,624	55,923,056	94,137,680
British India	Apr. 1	549,868,704	672,147,168	724,262,224	862,453,200	1,090,152,784
Canada	July 1	388,370,832	390,544,660	346,752,590	448,962,523	a 423,689,614
Cape of Good Hope	Jan. 1	120,365,406	104,629,048	101,468,941	82,805,094	87,165,626
Chile	Jan. 1	97,002,936	115,467,959	124,139,619	75,610,563	b 75,610,563
China	Jan. 1	607,880,000	435,711,467	509,959,200	626,433,333	896,422,400
Denmark	Jan. 1	42,051,621	77,374,516	82,865,127	76,080,072	45,254,827
Egypt	Jan. 1	22,844,441	16,920,099	45,843,510	86,880,895	76,321,099
Finland	Jan. 1	61,752,745	72,691,465	71,263,531	73,772,007	83,322,752
France	Jan. 1	220,187,363	288,073,883	179,849,557	179,460,755	222,562,321
Italy	Jan. 1	47,355,501	14,477,532	4,928,873	11,251,729	31,832,317
Japan	Jan. 1	351,750,533	523,131,067	547,300,400	289,129,733	104,816,933
Netherlands	Jan. 1	248,799,655	203,061,092	208,329,129	167,742,700	118,406,076
New Zealand	Jan. 1	84,878,074	88,197,686	91,841,944	89,439,230	93,329,376
Norway	Jan. 1	82,791,956	83,524,155	76,703,054	77,993,596	80,364,138
Persia	Mar. 21	c 167,114,080	179,412,238	154,815,921	154,217,415	b 154,217,415
Portugal	Jan. 1	63,630,016	68,765,610	72,490,231	70,011,389	b 70,011,389
Singapore	Jan. 1	93,271,733	102,369,867	114,407,600	117,958,267	b 117,958,267
Switzerland	Jan. 1	180,272,161	192,015,742	175,444,701	192,011,994	187,653,456
Turkey d	Jan. 1	273,612,826	273,612,826	273,612,826	273,612,826	273,612,826
United Kingdom	Jan. 1	3,440,232,768	3,099,985,504	3,409,501,648	3,099,597,648	3,420,616,976
United States	July 1	4,216,108,106	3,700,623,613	3,680,932,998	3,979,331,430	4,391,839,975
Uruguay	July 1	43,235,210	39,934,265	49,814,318	33,838,445	b 33,838,445
Other countries		312,617,000	361,562,533	383,861,800	587,122,591	a 552,306,790
Total		11,924,544,723	11,309,260,635	11,515,588,366	11,711,640,491	12,725,444,045

a Preliminary.
b Year preceding.
c Average 1903–1904.
d Imports for 1899, the latest available returns.

TEA.

International trade in tea, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
British India	Apr. 1	183,985,406	209,599,041	215,681,204	217,169,388	236,697,828
Ceylon	Jan. 1	150,829,707	149,227,236	157,929,342	170,183,558	162,191,321
China	Jan. 1	202,561,467	223,670,667	193,499,867	182,573,067	187,217,067
Dutch East Indies	Jan. 1	15,637,322	21,333,166	26,011,407	26,143,823	26,516,239
Formosa	Jan. 1	21,892,865	23,949,974	21,735,627	23,779,051	b 23,779,051
Japan	Jan. 1	43,334,372	47,858,393	47,108,802	38,565,730	39,711,327
Singapore	Jan. 1	1,903,867	1,955,067	2,752,933	2,411,600	b 2,411,600
Other countries		4,437,000	4,692,000	5,428,000	7,721,353	c 4,021,588
Total		624,582,006	682,285,544	670,147,182	668,547,570	682,546,021

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Argentina	Jan. 1	1,652,823	1,798,310	2,418,217	2,314,238	2,875,363
Australia	Jan. 1	24,822,544	24,716,426	28,688,974	28,353,903	29,478,614
Austria-Hungary	Jan. 1	2,258,194	2,364,457	2,662,742	2,755,998	2,857,411
British India	Apr. 1	3,921,563	4,817,821	5,135,126	6,302,248	4,836,515
Canada	July 1	23,969,371	31,360,014	26,314,242	25,632,627	c 26,490,580
Cape of Good Hope	Jan. 1	4,512,958	3,793,311	3,322,815	3,254,298	3,256,324
Chile	Jan. 1	1,883,307	1,977,766	1,760,302	2,496,479	b 2,496,479
Dutch East Indies	Jan. 1	4,218,013	4,458,883	4,044,820	4,962,110	5,113,929
France	Jan. 1	2,084,587	2,249,722	2,446,200	2,348,152	2,519,330
French Indo-China	Jan. 1	2,968,707	2,947,659	3,436,080	2,314,783	b 2,314,783
Germany d	Jan. 1	7,501,667	6,805,889	7,168,769	6,900,908	8,675,188
Netherlands	Jan. 1	7,989,226	7,926,262	8,794,208	9,090,607	9,559,206
New Zealand	Jan. 1	5,088,581	5,232,721	5,225,668	5,898,391	6,140,842
Persia	Mar. 1	d 6,353,224	6,922,170	5,784,277	6,997,776	b 6,997,776
Russia	Jan. 1	135,608,295	132,670,193	121,648,892	117,506,248	135,825,224
Singapore	Jan. 1	4,201,200	4,243,467	4,602,533	4,760,800	b 4,760,800
United Kingdom	Jan. 1	254,440,188	255,498,148	256,660,268	259,090,380	270,123,489
United States	July 1	108,574,905	112,905,541	102,706,599	93,621,750	86,362,490
Other countries		17,169,000	15,884,000	11,025,000	32,314,490	c 38,612,575
Total		619,218,353	628,572,760	603,845,732	616,916,186	649,296,918

a See "General note," p. 615.
b Year preceding.
c Preliminary.
d Not including free ports prior to March 1, 1906.

COFFEE.

International trade in coffee, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Brazil	Jan. 1	1,740,434,770	1,709,984,152	1,326,027,795	1,431,343,492	1,847,367,771
British India	Apr. 1	30,146,480	32,620,448	36,920,464	40,340,384	25,546,528
Colombia[b]	Jan. 1	60,000,000	100,000,000	130,000,000	70,000,000	70,000,000
Costa Rica	Sept. 1	30,311,568	38,211,860	27,730,672	39,788,002	30,367,032
Dutch East Indies	Jan. 1	115,448,887	116,334,830	77,168,254	72,864,649	64,820,671
Guatemala	Jan. 1	85,674,400	63,150,500	71,653,700	82,241,067	69,289,369
Haiti	Oct. 1	64,428,104	47,853,529	81,407,346	38,853,718	50,584,554
Jamaica	Apr. 1	12,079,872	8,966,832	5,781,440	9,046,464	6,144,432
Mexico	July 1	41,837,859	40,698,861	41,855,368	42,456,491	[c]31,217,333
Netherlands	Jan. 1	168,524,286	181,196,786	166,468,567	148,744,186	161,617,580
Nicaragua	Jan. 1	19,628,876	18,431,643	21,661,621	18,171,515	[d]18,171,515
Salvador	July 1	41,619,090	58,097,158	75,314,003	75,532,268	[d]75,532,268
Singapore	Jan. 1	12,355,333	15,125,067	10,638,667	7,813,067	[d]7,813,067
United States	July 1	29,768,945	32,614,390	16,109,251	29,184,504	41,033,423
Venezuela	July 1	71,206,846	125,582,423	[b]128,000,000	94,370,088	[d]94,370,088
Other countries		41,723,000	35,375,000	61,609,000	79,007,294	[c]86,980,247
Total		2,565,188,316	2,624,243,479	2,278,346,148	2,279,757,189	2,680,855,878

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Argentina	Jan. 1	12,117,621	18,502,868	16,931,049	18,516,812	20,229,490
Austria-Hungary	Jan. 1	99,434,846	104,200,357	108,701,092	107,106,048	112,757,597
Belgium	Jan. 1	69,660,936	51,859,425	154,387,057	100,032,285	119,040,964
Cape of Good Hope	Jan. 1	25,818,323	20,979,803	19,448,590	21,136,170	22,082,803
Cuba	Jan. 1	21,133,898	17,218,114	20,716,876	23,916,707	21,357,127
Denmark	Jan. 1	23,381,119	24,369,892	25,552,671	21,220,589	23,148,531
Egypt	Jan. 1	13,991,788	13,196,168	12,789,537	13,996,858	18,401,914
Finland	Jan. 1	22,130,291	25,598,739	23,291,871	25,743,433	29,085,091
France	Jan. 1	189,253,397	246,122,708	168,198,472	200,594,621	215,713,162
Germany[e]	Jan. 1	379,945,878	403,070,820	398,486,529	398,491,379	411,815,012
Italy	Jan. 1	35,846,933	38,934,065	39,087,728	41,287,279	45,046,159
Netherlands	Jan. 1	291,984,983	259,525,128	193,836,257	206,246,193	255,731,280
Norway	Jan. 1	28,340,658	27,996,473	23,699,731	25,311,450	28,265,935
Russia	Jan. 1	21,483,649	21,320,455	20,976,264	21,691,262	[c]23,762,222
Singapore	Jan. 1	13,046,800	14,958,400	9,174,666	7,784,667	[d]7,784,667
Spain	Jan. 1	20,419,436	21,851,660	22,000,781	24,084,186	28,518,089
Sweden	Jan. 1	57,555,152	68,349,071	60,623,344	66,417,080	77,507,951
Switzerland	Jan. 1	22,313,200	23,671,026	22,562,322	20,958,680	24,885,994
United Kingdom	Jan. 1	28,623,575	30,107,938	28,845,095	28,852,729	28,640,738
United States	July 1	915,086,380	995,043,284	1,047,792,984	851,668,933	985,321,473
Other countries		61,248,000	78,221,000	51,137,000	79,641,442	[c]78,096,168
Total		2,352,816,863	2,505,097,394	2,468,239,916	2,304,698,803	2,577,192,367

[a] See "General note," p. 615.
[b] Estimated.
[c] Preliminary.
[d] Year preceding.
[e] Not including free ports prior to March 1, 1906.

OIL CAKE AND OIL-CAKE MEAL.

International trade in oil cake and oil-cake meal, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	Jan. 1	18,984,000	19,989,308	29,019,439	29,277,380	29,524,298
Austria-Hungary	Jan. 1	64,246,433	88,614,781	92,352,938	77,134,433	58,999,874
Belgium	Jan. 1	128,843,692	137,066,773	145,834,669	160,163,061	176,470,002
Canada	July 1	28,830,032	29,002,624	10,115,392	26,227,376	[b] 44,397,360
China	Jan. 1	89,672,067	89,672,067	83,999,467	95,344,667	120,944,400
Denmark	Jan. 1	4,045,586	8,682,295	4,417,928	5,676,571	3,101,969
Egypt	Jan. 1	130,544,487	156,944,836	160,794,106	147,961,001	164,142,926
France	Jan. 1	325,867,127	314,693,035	351,628,964	339,529,396	323,482,202
Germany [c]	Jan. 1	328,769,326	375,254,222	436,964,238	397,800,450	361,592,621
Italy	Jan. 1	24,908,481	19,627,750	24,696,396	24,425,228	12,617,052
Netherlands	Jan. 1	139,814,583	136,734,208	154,525,289	143,290,470	147,620,993
Russia	Jan. 1	850,095,204	1,028,500,994	1,084,331,094	977,376,790	[b] 1,152,431,674
United Kingdom	Jan. 1	53,146,240	53,146,240	48,462,400	57,830,080	58,524,480
United States	July 1	1,679,394,359	1,503,232,680	1,894,577,648	1,918,171,984	2,063,732,272
Other countries	....	11,491,000	14,337,000	26,149,000	273,670,241	[b] 195,457,901
Total	....	3,878,652,617	3,975,498,813	4,547,868,968	4,673,879,128	4,913,040,024

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	7,656,432	21,750,580	27,340,840	26,469,794	24,769,590
Belgium	Jan. 1	353,641,510	421,696,899	445,202,134	448,216,564	510,213,668
Canada	July 1	3,521,616	3,808,224	3,953,376	2,308,432	[b] 3,656,912
Denmark	Jan. 1	654,111,347	776,875,723	757,481,664	842,875,492	846,259,587
Dutch East Indies	Jan. 1	15,691,801	15,977,041	31,004,951	19,075,498	26,850,775
Finland	Jan. 1	12,594,155	7,205,192	13,948,954	11,179,475	14,543,404
France	Jan. 1	238,507,681	279,980,299	292,015,079	323,719,234	237,725,713
Germany [c]	Jan. 1	1,074,490,655	1,108,355,853	1,231,409,255	1,285,529,859	1,325,622,674
Italy	Jan. 1	7,909,522	9,645,221	6,525,902	5,209,963	7,851,541
Japan	Jan. 1	55,550,267	78,582,800	82,023,067	110,074,533	134,060,400
Netherlands	Jan. 1	461,479,090	476,967,295	495,921,130	510,951,427	564,097,473
Sweden	Jan. 1	142,046,653	163,933,913	219,913,686	226,374,498	264,890,580
United Kingdom	Jan. 1	861,678,720	811,798,400	823,934,720	797,368,320	797,115,200
Other countries	....	21,898,000	25,702,000	54,076,000	153,688,134	[b] 112,894,136
Total	....	3,910,777,449	4,202,279,440	4,484,750,758	4,763,041,223	4,370,551,653

[a] See "General note," p. 615. [b] Preliminary. [c] Not including free ports prior to March 1, 1906.

ROSIN.

International trade in rosin, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Austria-Hungary	Jan. 1	3,378,583	3,327,436	3,627,485	3,372,410	3,132,547
Germany [b]	Jan. 1	33,756,511	44,552,765	45,617,597	46,370,255	46,088,946
Netherlands	Jan. 1	74,856,747	63,038,801	83,943,225	58,544,509	79,550,046
United States	July 1	671,019,440	723,830,240	646,877,000	682,795,680	717,070,480
Other countries	....	288,000	373,000	338,000	677,886	[c] 520,893
Total	....	783,299,281	835,122,242	780,403,307	791,760,740	846,362,912

[a] See "General note," p. 615. [b] Not including free ports prior to March 1, 1906. [c] Preliminary.

International trade in rosin, 1902–1906 [a]—Continued.

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	Jan. 1	18,292,214	19,761,229	27,846,666	20,409,438	22,957,066
Australia	Jan. 1	13,646,416	8,989,904	15,552,880	14,037,408	11,566,016
Austria-Hungary	Jan. 1	58,450,261	72,122,004	64,824,926	62,482,294	72,599,746
Brazil	Jan. 1	23,552,810	26,729,827	26,297,077	27,492,124	21,608,739
Canada	July 1	17,988,880	29,337,280	19,116,272	21,140,224	[b] 22,183,392
Chile	Jan. 1	2,348,919	3,844,971	1,935,923	2,108,756	[c] 2,108,756
Cuba	Jan. 1	3,076,821	2,963,173	2,184,454	1,760,478	1,536,070
Denmark	Jan. 1	2,338,002	1,630,318	2,135,176	2,033,764	2,326,979
Finland	Jan. 1	3,071,429	4,397,180	3,389,950	5,133,632	3,893,252
France	Jan. 1	1,007,975	903,121	793,596	693,940	863,564
Germany [d]	Jan. 1	[e] 197,538,981	[e] 236,486,054	[e] 233,541,561	[e] 208,295,553	[e] 235,300,629
Italy	Jan. 1	29,474,694	25,020,035	32,527,875	27,539,477	[b] 32,796,618
Japan	Jan. 1	5,011,866	3,275,449	5,463,167	6,378,787	6,599,144
Netherlands	Jan. 1	94,202,927	68,258,334	89,756,661	78,666,949	80,488,983
Russia	Jan. 1	65,531,334	67,526,025	65,493,091	59,632,597	[b] 60,019,474
Servia	Jan. 1	1,626,832	6,751,840	4,887,332	7,894,169	1,371,797
Spain	Jan. 1	5,399,144	4,823,960	3,983,117	3,684,871	2,895,070
Sweden	Jan. 1	11,123,176	9,940,220	13,440,652	11,443,057	13,110,667
Switzerland	Jan. 1	5,127,510	6,297,062	6,640,101	5,736,867	5,577,914
United Kingdom	Jan. 1	202,016,416	183,607,872	199,577,952	177,010,624	174,996,752
Uruguay	July 1	5,494,359	4,390,394	5,693,582	4,881,232	[c] 4,881,232
Other countries		4,194,157	2,740,733	9,729,135	14,460,972	[b] 17,929,392
Total		770,515,123	789,796,985	834,811,146	762,917,213	797,611,252

[a] See "General note," p. 615.
[b] Preliminary.
[c] Year preceding.
[d] Not including free ports prior to March 1, 1906.
[e] Including turpentine.

International trade in spirits of turpentine, 1902–1906. [a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Gallons.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
France	Jan. 1	925,794	1,975,963	1,459,297	3,179,105	3,367,371
Germany [b]	Jan. 1	502,439	612,058	569,650	520,750	460,735
Netherlands	Jan. 1	1,288,879	988,059	876,929	972,714	1,400,645
Russia	Jan. 1	1,516,096	1,887,430	2,163,759	2,504,423	[c] 2,502,818
United States	July 1	16,378,787	17,202,808	15,894,813	15,981,253	15,854,676
Other countries		60,266	71,979	112,536	89,867	[c] 98,995
Total		20,672,261	22,738,297	21,076,984	23,248,112	23,685,240

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Argentina	Jan. 1	252,938	276,360	344,877	290,804	570,426
Australia	Jan. 1	213,099	226,272	437,032	291,809	377,650
Austria-Hungary	Jan. 1	1,821,967	1,739,722	2,071,855	2,021,485	2,190,476
Canada	July 1	941,003	817,020	963,138	1,077,989	[c] 868,848
Chile	Jan. 1	69,044	163,911	85,896	136,124	[d] 136,124
Germany [b]	Jan. 1	8,077,490	8,300,249	8,438,956	8,539,910	9,966,790
Italy	Jan. 1	663,193	771,465	816,629	687,291	948,171
Netherlands	Jan. 1	3,245,616	2,729,815	2,220,156	2,248,055	2,711,797
New Zealand	Jan. 1	130,881	69,596	285,631	153,999	158,398
Russia	Jan. 1	142,746	201,133	204,734	192,902	[c] 215,674
Sweden	Jan. 1	124,723	126,194	138,884	115,383	141,077
Switzerland	Jan. 1	313,363	360,303	372,367	346,279	462,297
United Kingdom	Jan. 1	7,942,324	8,012,184	7,907,418	7,693,933	7,673,758
Other countries		407,711	493,579	584,669	712,497	[c] 1,684,925
Total		24,346,098	24,287,803	24,872,242	24,508,460	28,106,411

[a] See "General note," p. 615.
[b] Not including free ports prior to March 1, 1906.
[c] Preliminary.
[d] Year preceding.

INDIA RUBBER.

International trade in india rubber, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Angola	Jan. 1	2,564,948	6,137,046	5,617,377	[b] 5,200,000	[b] 5,200,000
Belgium	Jan. 1	13,016,353	14,088,566	16,335,876	14,997,420	16,940,908
Bolivia	Jan. 1	4,195,380	2,912,381	4,915,638	3,728,726	[c] 3,728,726
Brazil	Jan. 1	63,122,428	69,923,121	70,251,499	78,027,329	77,073,991
Dutch East Indies	Jan. 1	426,848	1,475,551	3,590,489	4,569,275	4,564,932
Ecuador	Jan. 1	870,405	1,090,988	1,145,447	1,293,134	1,394,575
France	Jan. 1	6,011,956	6,390,101	6,632,627	10,766,377	13,033,578
French Guinea	Jan. 1	[b] 2,426,000	3,280,045	2,952,245	3,121,366	[c] 3,121,366
French Kongo	Jan. 1	1,518,469	1,857,491	2,753,778	3,716,860	[c] 3,716,860
Germany [d]	Jan. 1	13,748,023	11,237,840	10,073,138	18,654,850	12,589,053
Gold Coast Colony	Jan. 1	1,599,974	2,258,981	4,013,837	3,687,778	3,649,668
Ivory Coast	Jan. 1	2,011,471	2,572,379	3,386,399	2,602,638	[c] 2,602,638
Kamerun	Jan. 1	935,441	1,822,144	1,920,354	2,141,777	2,537,540
Kongo Free State	Jan. 1	11,795,724	[b] 13,350,000	[b] 10,040,000	10,718,358	10,690,060
Netherlands	Jan. 1	3,544,851	3,231,008	3,998,671	5,760,814	5,605,388
Peru	Jan. 1	3,749,760	4,648,000	4,896,298	5,598,785	[c] 5,598,785
Senegal	Jan. 1	1,212,262	1,801,957	2,208,623	2,242,786	[c] 2,242,786
Singapore	Jan. 1	920,533	1,441,200	3,026,133	5,053,067	[c] 5,053,067
Southern Nigeria Protectorate	Jan. 1	865,834	1,177,803	2,408,926	2,842,831	3,434,279
Venezuela	July 1	1,673,308	1,794,626	[e] 2,429,461	3,064,296	[c] 3,064,296
Other countries		4,664,000	5,970,000	8,921,000	13,410,920	[f] 21,504,908
Total		140,873,968	158,461,228	171,517,816	201,199,387	207,347,404

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	2,640,476	2,789,508	2,935,675	3,021,875	4,203,332
Belgium	Jan. 1	15,908,530	16,977,346	17,983,033	18,744,212	20,813,089
Canada	July 1	2,858,778	3,213,277	2,810,238	2,490,756	[f] 2,963,152
France	Jan. 1	12,061,674	12,708,795	14,611,040	19,693,018	23,053,199
Germany [d]	Jan. 1	33,132,823	34,362,782	38,375,855	47,627,110	38,849,408
Italy	Jan. 1	1,556,022	1,470,042	1,474,451	1,690,725	2,586,242
Netherlands	Jan. 1	4,159,714	4,422,234	5,371,310	6,645,498	8,189,950
Russia	Jan. 1	10,960,379	14,388,134	13,064,780	12,913,540	[f] 16,684,114
United Kingdom	Jan. 1	14,293,888	16,784,992	22,140,048	29,000,832	31,004,400
United States	July 1	55,010,571	59,015,551	67,234,256	57,844,345	76,963,838
Other countries		3,026,000	3,926,000	8,091,000	9,256,056	[f] 9,161,152
Total		155,608,855	170,058,661	194,091,686	208,927,967	234,471,876

[a] See "General note," p. 615.
[b] Estimated.
[c] Year preceding.
[d] Not including free ports prior to March 1, 1906.
[e] Average, 1903 and 1905.
[f] Preliminary.

WOOD PULP.

International trade in wood pulp, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Austria-Hungary	Jan 1	98,315,779	105,874,767	147,236,342	166,589,396	148,332,700
Belgium	Jan. 1	57,585,053	55,958,478	68,359,246	54,872,925	68,233,066
Canada	July 1	309,120,000	271,040,000	369,600,000	361,870,000	[b] 404,494,720
Finland	Jan. 1	57,060,121	80,804,723	130,027,777	133,477,320	123,858,426
Germany [c]	Jan. 1	185,744,254	161,354,520	155,086,119	153,651,351	156,740,026
Norway	Jan. 1	986,501,986	987,105,611	981,629,727	975,158,500	1,114,716,540
Sweden	Jan. 1	632,302,111	790,806,214	865,367,383	846,213,535	914,501,238
Switzerland	Jan. 1	12,550,693	15,455,503	14,938,960	14,004,420	13,901,905
United States	July 1	22,464,472	30,230,820	23,703,906	29,482,434	25,079,946
Other countries		511,000	505,000	3,137,000	49,843,083	[b] 80,408,838
Total		2,362,155,469	2,499,135,636	2,759,086,460	2,785,162,964	3,050,267,405

[a] See "General note," p. 615.
[b] Preliminary.
[c] Not including free ports prior to March 1, 1906.

International trade in wood pulp, 1902–1906 [a]—Continued.

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	Jan. 1	14,967,598	26,578,411	35,123,171	30,886,404	37,368,826
Austria-Hungary	Jan. 1	7,271,725	4,981,343	5,342,681	4,702,018	4,262,416
Belgium	Jan. 1	183,481,383	159,206,350	177,288,153	174,530,060	228,929,053
Denmark	Jan. 1	60,458,958	61,638,806	64,605,345	67,310,417	64,300,231
France	Jan. 1	437,465,059	420,541,812	465,941,055	490,998,886	563,826,785
Germany [b]	Jan. 1	63,259,203	91,195,732	155,961,354	109,748,067	103,547,347
Italy	Jan. 1	58,479,583	67,924,624	85,246,119	93,789,911	114,677,382
Japan	Jan. 1	8,292,550	16,039,691	22,726,098	22,769,993	37,020,666
Russia	Jan. 1	68,889,680	57,929,301	49,107,233	44,467,063	[c] 46,404,948
Spain	Jan. 1	73,125,213	59,570,926	62,599,816	70,535,843	76,781,583
Sweden	Jan. 1	5,464,912	5,657,726	6,918,148	6,579,205	7,882,006
Switzerland	Jan. 1	6,943,016	10,344,527	14,229,512	19,680,440	16,764,827
United Kingdom	Jan. 1	1,170,881,600	1,281,295,680	1,263,028,480	1,280,780,480	1,341,735,360
United States	July 1	261,813,440	324,343,040	375,208,960	352,181,760	477,366,400
Other countries	....	5,999,000	12,693,000	2,753,000	119,801,943	[c] 113,791,839
Total	....	2,426,792,920	2,599,940,969	2,786,079,125	2,888,762,490	3,234,659,669

[a] See "General note," p. 615.
[b] Not including free ports prior to March 1, 1906.
[c] Preliminary.

SILK.

Raw silk production of countries named, 1902–1906.

[Estimate of the Silk Manufacturers' Association of Lyons.]

Country.	1902.	1903.	1904.	1905.	1906.
Western Europe:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Italy	9,870,000	7,774,000	10,803,000	9,788,000	10,461,000
France	1,257,000	1,045,000	1,378,000	1,393,000	1,333,000
Spain	172,000	190,000	170,000	172,000	124,000
Austria-Hungary	688,000	606,000	694,000	761,000	754,000
Total	11,987,000	9,615,000	13,045,000	12,114,000	12,672,000
Levant and Central Asia:					
Anatolia	1,109,000	1,160,000	1,096,000	1,424,000	1,221,000
Syria and Cyprus	1,190,000	1,124,000	1,036,000	1,080,000	1,037,000
Salonica and Adrianople	419,000	547,000	564,000	617,000	567,000
Balkan States	287,000	300,000	337,000	419,000	408,000
Greece and Crete	143,000	132,000	143,000	155,000	165,000
Caucasus	1,025,000	882,000	794,000	640,000	1,003,000
Persia and Turkestan (exports)	1,213,000	1,433,000	939,000	1,014,000	1,385,000
Total	5,386,000	5,578,000	4,909,000	5,349,000	5,786,000
Far East:					
China—					
Exports from Shanghai	7,937,000	9,356,000	9,293,000	8,841,000	9,396,000
Exports from Canton	4,892,000	4,733,000	4,705,000	4,409,000	4,325,000
Japan—					
Exports from Yokohama	10,516,000	10,159,000	12,846,000	10,183,000	13,210,000
British India—					
Exports from Calcutta and Bombay [a]	650,000	540,000	397,000	617,000	717,000
Total	23,995,000	24,788,000	27,241,000	24,050,000	27,648,000
Grand total	41,368,000	39,981,000	45,195,000	41,513,000	46,106,000

[a] Exports from Bombay included for the first time in 1905.

CLOVER AND TIMOTHY SEED.

Wholesale prices of clover seed (60 pounds to the bushel), 1903–1907.

Date.	Cincinnati.		Chicago.		Toledo.		Detroit.	
	Prime (per bushel).		Poor to choice (per 100 pounds).		Prime (per bushel).		Per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
January	$5.25	$6.50	$8.50	$11.90	$4.40	$7.42½	$7.25	$7.30
February	6.00	6.50	9.25	11.90	5.25	7.25	7.00	7.10
March	6.25	7.10	....	12.50	4.00	7.42½	6.95	7.40
April	6.00	6.90	5.00	12.25	3.60	7.62½	6.60	7.25
May	5.40	7.00	8.00	12.50	4.00	7.70	7.50	7.50
June	5.40	6.00	8.00	11.75	6.00	6.75	Not quoted.	
July	....	....	8.00	12.50	6.40	7.10	Not quoted.	
August	....	....	8.50	12.50	4.85	7.10	Not quoted.	
September	5.00	5.70	5.00	11.00	4.00	6.65	Not quoted.	
October	5.25	5.70	6.00	11.50	3.75	6.80	6.45	6.90
November	5.25	5.60	4.00	11.00	3.40	6.82½	6.50	6.60
December	5.25	6.00	6.00	11.25	3.05	7.05	6.80	6.95
1904.								
January	5.75	6.25	6.00	11.50	3.10	7.07½	6.75	7.00
February	5.75	6.25	6.00	11.25	4.00	7.02½	6.75	6.90
March	5.75	6.90	6.00	11.65	2.50	7.15	6.20	7.10
April	5.50	6.50	7.50	11.00	3.00	6.62½	6.20	6.55
May	4.80	5.00	6.00	10.75	3.00	6.35	6.30	6.35
June	4.80	5.00	6.00	10.75	2.50	6.25	....	....
July	4.80	5.00	7.00	11.25	3.00	6.60	6.25	6.50
August	4.80	6.50	8.00	12.75	5.70	7.60	6.50	7.50
September	6.00	6.50	9.00	12.50	3.60	7.45	7.05	7.45
October	5.50	6.75	7.00	12.25	3.00	7.52½	7.30	7.55
November	5.50	6.50	7.00	12.25	3.30	7.70	7.35	7.65
December	5.50	7.50	7.00	13.00	3.62½	7.95	7.70	7.95
1905.			(a)					
January	6.40	7.00	8.00	13.00	3.25	8.00	7.45	7.90
February	6.40	7.00	9.00	12.50	4.00	7.60	7.40	7.55
March	6.40	7.00	9.00	13.75	3.00	8.20	7.55	8.15
April	6.40	7.75	8.00	14.40	3.00	8.85	8.00	8.75
May	6.25	7.75	8.00	13.50	3.50	8.00	7.00	8.00
June	6.25	6.75	8.00	13.00	5.50	7.40	....	....
July	6.25	6.75	9.00	13.00	5.75	7.50	....	....
August	....	....	8.50	13.00	4.00	7.50	....	....
September	5.70	6.00	9.00	12.25	3.00	7.45	6.30	7.40
October	5.70	7.00	9.50	13.25	3.00	8.22½	7.50	8.25
November	6.50	7.00	10.00	13.25	4.00	8.12½	7.95	8.10
December	6.50	7.50	10.00	13.25	4.00	8.30	8.00	8.15
1906.								
January	6.50	7.50	10.00	13.25	5.00	8.35	8.10	8.30
February	6.50	7.50	10.00	14.15	4.00	8.72½	8.20	8.70
March	6.50	7.50	9.50	14.00	3.30	8.40	7.30	8.35
April	6.00	7.50	7.00	13.50	3.25	7.85	6.25	7.80
May	6.00	6.50	6.50	11.50	3.00	6.80	6.25	6.75
June	4.50	5.50	7.00	11.25	5.00	6.90	6.65	6.75
July	4.50	6.00	7.00	11.25	5.25	7.10	6.65	6.95
August	4.50	7.00	7.00	12.50	4.50	7.35	7.00	7.50
September	5.00	7.00	8.00	12.75	3.50	8.10	7.30	7.90
October	5.00	7.25	8.00	13.00	3.60	8.50	7.95	8.30
November	7.00	7.50	8.00	13.40	3.50	8.30	8.00	8.25
December	7.00	7.50	8.50	14.00	3.00	8.47½	8.20	8.40
1907.					(b)			
January	7.00	7.50	9.00	14.00	3.00	8.65	8.30	8.60
February	7.00	7.50	9.00	13.85	3.00	8.47½	8.00	8.45
March	7.00	7.50	9.00	15.75	3.15	9.50	8.00	9.25
April	7.00	7.50	8.00	15.50	3.10	9.35	8.45	9.25
May	7.00	7.50	8.00	15.25	3.25	9.25	8.75	9.25
June	7.00	7.50	8.50	15.25	7.25	9.35	9.00	9.00
July	7.00	7.50	8.50	15.50	3.05	9.60	9.00	9.25
August	7.50	8.50	8.50	16.25	8.00	10.00	9.00	9.50
September	7.50	8.50	9.00	16.75	6.50	10.75	9.00	10.50
October	7.50	8.50	10.00	17.00	3.00	11.00	9.50	10.75
November	7.50	8.50	9.00	16.50	3.00	9.80	9.35	9.50
December	7.50	8.50	9.50	17.00	3.00	10.37½	9.50	10.25

[a] Poor to prime.

[b] Poor to choice.

Wholesale prices of timothy seed (45 pounds to the bushel), 1903–1907.

Date.	Cincinnati.		Chicago.		Milwaukee.		St. Louis.[a]	
	Per bushel.		Per 100 pounds.		Per 100 pounds.		Per 100 pounds.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
January	$1.55	$1.70	$2.50	$4.35	$3.00	$3.75	$3.00	$3.60
February	1.55	1.70	2.50	4.35	3.00	3.75	2.75	3.60
March	1.45	1.65	2.00	3.95	2.00	3.75	2.00	3.25
April	1.35	1.50	2.00	3.70	2.00	3.25	2.00	2.80
May	1.35	1.50	2.00	3.75	2.25	2.90	2.00	2.40
June	1.35	1.60	2.00	4.00	2.35	3.35	2.00	2.50
July	....	....	1.75	3.65	2.60	3.35	2.40	3.20
August	....	....	1.75	3.40	2.50	3.25	2.75	3.51
September	1.35	1.50	2.50	3.40	2.50	3.25	2.50	3.26
October	1.25	1.50	2.00	3.17½	2.30	3.00	2.48	3.20
November	1.25	1.40	2.00	3.00	2.25	2.85	2.20	2.85
December	1.20	1.40	2.00	3.05	2.25	2.75	2.25	2.85
1904.								
January	1.20	1.35	2.00	3.25	2.25	3.15	2.25	2.80
February	1.25	1.35	2.25	3.25	2.50	3.15	2.50	2.80
March	1.25	1.35	2.00	3.25	2.00	3.15	2.40	2.75
April	1.20	1.35	2.00	3.00	2.00	2.90	2.40	2.68
May	1.20	1.30	2.00	3.05	2.25	2.90	2.40	2.75
June	1.20	1.30	2.00	3.05	2.25	2.90	2.40	2.75
July	1.20	1.30	2.00	3.25	2.00	3.00	2.40	2.75
August	1.20	1.35	2.00	3.05	2.50	3.00	2.40	2.80
September	1.15	1.35	2.00	3.00	2.25	3.00	2.00	2.76
October	1.15	1.25	1.75	2.75	2.10	2.80	2.00	2.45
November	1.15	1.30	1.75	2.70	2.10	2.65	2.00	2.40
December	1.15	1.30	1.75	2.72½	2.25	2.65	2.00	2.40
1905.				(a)				
January	1.15	1.30	1.75	2.80	2.25	2.65	2.00	2.40
February	1.15	1.30	2.00	2.92½	2.25	2.65	2.00	2.50
March	1.15	1.30	2.25	3.10	2.25	2.90	2.00	2.50
April	1.15	1.30	2.00	3.10	2.50	2.90	2.00	2.75
May	1.20	1.30	2.00	3.10	2.50	2.90	2.00	2.50
June	1.20	1.30	2.00	3.00	2.25	2.90	2.00	2.50
July	1.20	1.30	2.50	3.30	2.25	2.95	2.40	2.75
August	1.20	1.45	2.00	3.60	2.35	3.50	2.40	3.70
September	1.40	1.60	2.00	3.75	2.70	3.40	3.00	3.70
October	1.35	1.55	2.00	3.40	2.40	3.50	2.50	3.10
November	1.35	1.40	1.50	3.50	2.50	3.10	2.50	2.80
December	1.30	1.35	1.50	3.50	2.50	3.10	2.50	2.80
1906.								
January	1.30	1.35	2.00	3.40	2.50	3.10	2.60	2.80
February	1.30	1.35	2.25	3.35	2.60	2.80	2.60	3.20
March	1.30	1.35	2.00	3.25	2.40	2.75	2.50	3.05
April	1.30	1.35	2.00	3.20	2.45	2.80	2.50	3.20
May	1.30	1.35	2.00	3.35	2.60	2.95	2.40	3.20
June	1.35	1.45	2.25	4.25	2.70	4.00	2.40	4.00
July	1.50	1.80	2.50	4.25	3.25	4.00	3.00	4.00
August	1.50	1.80	2.50	4.10	3.15	3.75	3.00	4.00
September	1.50	1.80	3.00	4.30	3.10	3.75	3.60	4.00
October	1.50	1.80	3.00	4.25	3.10	3.75	3.25	4.00
November	1.50	1.80	3.00	4.40	3.10	3.75	3.25	4.00
December	1.50	1.85	3.25	4.50	3.10	4.25	3.25	4.00
1907.								
January	1.50	1.85	3.25	4.45	3.50	4.25	3.25	4.25
February	1.50	2.00	3.15	4.55	3.50	4.35	3.50	4.45
March	1.75	2.00	3.00	4.60	3.50	4.35	3.00	4.45
April	1.75	2.00	3.00	4.35	3.40	4.15	3.00	4.00
May	1.75	2.25	3.25	4.75	3.25	4.00	3.00	4.05
June	1.75	2.00	3.50	4.75	3.75	4.50	3.00	4.00
July	1.75	2.00	3.50	4.75	3.75	4.65	3.25	4.25
August	1.75	2.15	3.50	4.65	3.50	4.65	3.25	4.50
September	1.75	2.15	3.50	4.75	3.50	4.40	3.75	4.60
October	1.75	2.15	3.50	4.60	3.80	4.40	3.50	4.50
November	1.75	2.15	3.25	4.70	3.50	4.40	3.50	4.30
December	1.75	2.15	3.00	4.35	3.50	4.25	3.50	4.20

[a] Poor to prime.

BEANS.

Wholesale prices of beans per bushel, 1903–1907.

Date.	Boston.		Cincinnati.		Chicago.		Detroit.		San Francisco.	
	Pea.		Navy.		Pea.		Pea.		Small white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.										
January	$2.40	$2.45	$2.40	$2.50	$1.25	$2.40	$2.24	$2.35	$2.90	$3.40
February	2.35	2.40	2.25	2.50	1.20	2.30	2.10	2.23	2.90	3.35
March	2.25	2.30	2.30	2.40	1.25	2.25	2.10	2.16	3.00	3.30
April	2.25	2.30	2.15	2.40	.90	2.20	1.88	2.10	3.00	3.30
May	2.25	2.35	2.15	2.25	.90	2.30	2.07	2.35	2.90	3.25
June	2.35	2.35	2.15	2.25	1.25	2.35	2.20	2.25	3.00	3.25
July	2.30	2.35	2.15	2.25	1.20	2.23	2.10	2.21	3.00	3.25
August	2.20	2.30	2.15	2.25	1.15	2.25	1.91	1.96	3.00	3.20
September	2.30	2.40	2.15	2.25	1.50	2.50	2.10	2.35	2.85	3.25
October	2.25	2.40	2.15	2.25	1.05	2.25	1.90	2.28	3.00	3.25
November	2.15	2.20	2.15	2.25	1.05	2.15	1.90	2.00	2.75	3.15
December	2.10	2.15	2.05	2.25	1.35	2.00	1.82	1.90	2.40	3.00
1904.										
January	2.00	2.10	2.05	2.10	1.00	1.90	1.75	1.77	2.75	3.00
February	2.00	2.20	2.05	2.10	1.25	2.05	1.74	1.98	2.80	3.00
March	2.00	2.20	2.05	2.10	1.25	2.05	1.70	1.95	2.85	3.10
April	1.95	2.00	2.05	2.10	1.00	1.85	1.70	1.80	2.90	3.15
May	1.95	2.00	2.05	2.10	1.10	1.80	1.70	1.87	2.95	3.10
June	1.85	1.95	2.05	2.10	1.10	1.78	1.60	1.70	2.90	3.05
July	1.80	1.80	2.05	2.10	1.10	1.70	1.60	1.61	2.75	3.00
August	1.75	1.90	2.05	2.10	1.10	1.65	1.61	1.78	2.75	3.00
September	1.75	1.90	2.05	2.10	.90	1.65	....	....	2.75	3.10
October	1.85	1.95	2.05	2.10	.90	1.75	1.65	1.72	2.75	3.32½
November	1.80	1.85	1.80	1.90	1.10	1.70	1.58	1.64	2.75	3.30
December	1.72½	1.80	1.80	1.90	1.20	1.70	1.58	1.62	2.75	3.30
1905.										
January	1.75	1.75	1.80	1.90	1.25	1.62	1.56	1.65	2.75	3.30
February	1.75	2.00	1.80	1.90	1.00	1.85	1.52	1.85	2.75	3.30
March	1.80	1.97	1.80	1.90	1.30	1.80	1.70	1.77	2.75	3.45
April	1.75	1.80	1.80	1.90	1.30	1.70	1.66	1.75	2.75	3.45
May	1.75	1.80	1.80	1.90	1.30	1.70	1.62	1.68	2.75	3.40
June	1.80	1.90	1.80	1.90	1.30	1.75	1.65	1.69	2.75	3.50
July	1.85	1.90	1.80	1.90	1.25	1.78	1.66	1.68	2.75	3.60
August	1.75	1.85	1.80	1.90	1.20	1.72½	1.55	1.63	2.75	3.60
September	1.75	1.75	1.80	1.90	1.25	1.68	1.50	1.65	3.00	3.60
October	1.75	1.75	1.65	1.75	1.25	1.65	1.49	1.63	3.00	3.60
November	1.75	1.85	1.65	1.75	1.40	1.70	1.55	1.68	2.75	3.15
December	1.75	1.85	1.65	1.75	1.40	1.70	1.55	1.65	2.75	3.20
1906.										
January	1.75	1.80	1.65	1.75	1.40	1.62	1.55	1.61	....	....
February	1.65	1.75	1.65	1.75	1.37	1.58	1.45	1.55	....	....
March	1.55	1.60	1.65	1.75	1.35	1.55	1.40	1.47	....	....
April	1.60	1.65	1.65	1.75	1.10	1.62	1.44	1.52	....	....
May	1.60	1.70	1.65	1.75	1.20	1.62	1.48	1.54	....	....
June	1.60	1.72	1.65	1.75	1.25	1.65	1.48	1.55	....	....
July	1.60	1.62	1.65	1.75	1.25	1.64	1.50	1.52	....	....
August	1.55	1.60	1.65	1.75	1.25	1.58	1.41	1.50	....	....
September	1.50	1.55	1.65	1.75	1.39	1.53	1.30	1.44	....	....
October	1.55	1.65	1.65	1.75	1.40	1.48	1.37	1.40	....	....
November	1.60	1.65	1.65	1.75	1.40	1.46	1.34	1.37	....	....
December	1.50	1.55	1.65	1.75	1.35	1.45	1.27	1.30	....	....
1907.					(a)					
January	1.50	1.50	1.65	1.75	1.20	1.38	1.28	1.31	2.60	2.95
February	1.50	1.55	1.65	1.70	1.10	1.39	1.31	1.36	2.60	3.00
March	1.45	1.55	1.65	1.70	1.10	1.36	1.30	1.36	2.75	3.00
April	1.42	1.47	1.65	1.75	1.10	1.35	1.32	1.36	2.85	3.10
May	1.45	1.90	1.65	1.75	1.10	1.77	1.38	1.73	2.80	3.05
June	1.80	1.90	1.65	1.75	1.55	1.83	1.64	1.74	2.80	3.00
July	1.70	1.75	1.65	1.70	1.15	1.68	1.50	1.65	2.75	3.00
August	1.70	1.80	1.65	1.70	1.15	1.85	1.48	1.60	2.85	3.00
September	1.90	2.25	1.65	1.70	1.35	2.25	1.75	2.06	2.85	3.15
October	2.35	2.45	1.65	1.70	1.85	2.40	2.00	2.25	3.00	3.60
November	2.45	2.45	1.65	2.25	1.85	2.65	1.90	2.10	3.40	3.60
December	2.30	2.40	2.00	2.25	1.85	2.15	1.90	2.00	3.40	3.55

a Common to fine.

FARM ANIMALS AND THEIR PRODUCTS.

[Figures furnished by the Bureau of Statistics, Department of Agriculture, except where otherwise credited. All prices on gold basis.]

Live stock of countries named.

[Africa incompletely represented, through lack of statistics for large areas. Number of animals in China, Persia, Afghanistan, Korea, Bolivia, Ecuador, Salvador, and several less important countries unknown. For Brazil number of cattle alone estimated, but roughly. In general, statistics of cattle, horses, sheep, and swine much more complete than those of other animals, as statements for the world.]

Country.	Year.	Cattle. Total.	Cattle. Dairy cows.	Horses.	Mules.	Sheep.	Swine.
NORTH AMERICA.							
United States:							
Contiguous—							
On farms	1908	71,267,000	21,194,000	19,992,000	3,869,000	54,631,000	56,084,000
Not on farms	1900	1,616,422	973,033	2,936,881	173,908	231,301	1,818,114
Noncontiguous—							
Alaska *a*	1900	18	13	5	.....	.....	10
Hawaii *a*	1900	102,908	4,028	12,982	6,506	102,098	8,057
Porto Rico	1899	260,225	73,372	58,664	6,985	6,363	66,180
Total United States (except Philippine Islands)	.....	73,246,573	22,244,446	23,000,532	4,056,399	54,970,762	57,976,361
Bermuda	1905	.....	.....	*b* 1,246	.....	.....	.....
Canada:							
New Brunswick	1906	229,000	*c* 111,084	63,000	.....	188,000	52,000
Ontario	1907	2,889,503	1,106,984	672,781	.....	1,324,153	1,906,460
Manitoba	1906	521,112	170,143	215,819	.....	28,975	200,509
Saskatchewan	1906	472,854	112,618	240,566	.....	121,290	123,916
Alberta	1906	950,632	101,245	226,534	.....	154,266	114,623
Other	1901	2,123,932	1,033,295	531,249	.....	1,178,872	561,866
Total Canada	.....	7,187,033	2,635,369	1,949,949	.....	2,995,556	2,959,374
Central America:							
Guatemala	1898	196,768	.....	50,343	.....	77,593	29,784
Honduras	1907	600,000	.....	45,000	15,000	15,000	120,000
Nicaragua	.....	1,200,000	.....	.....	.....	.....	.....
Panama	1906	156,569	.....	30,863	1,500	.....	28,000
Costa Rica	1905	308,160	*d* 93,155	54,974	2,987	250	79,730
Mexico	1902	5,142,457	.....	859,217	334,435	3,424,430	616,139
Newfoundland	1901	32,767	.....	8,851	.....	78,052	34,679
West Indies:							
British—							
Barbados	1906	.....	.....	2,441	.....	.....	.....
Dominica	1906	*e* 1,437	.....	568	.....	*e* 1,088	.....
Grenada	1901	1,908	.....	1,074	.....	1,975	.....
Jamaica	1906	110,258	.....	68,056	.....	16,029	29,000
Montserrat	1906	.....	.....	286	.....	.....	.....
Turks and Caicos Islands	1906	800	.....	105	.....	125	.....
Virgin Islands	1906	2,000	.....	255	.....	300	.....
Cuba	*f* 1906	2,176,178	*g* 1,053,847	342,568	45,559	*h* 9,982	*h* 358,868
Dutch	1905	3,567	.....	741	164	21,720	3,990
Guadeloupe	(*i*)	30,560	.....	8,819	6,311	11,731	32,656
Total North America	.....	90,397,035	.....	26,425,888	4,462,355	61,624,593	62,268,581
SOUTH AMERICA.							
Argentina	1907	25,844,800	.....	5,374,170	544,870	77,582,100	2,844,000
Brazil	.....	30,000,000	.....	.....	.....	.....	.....
British Guiana	1906	85,000	.....	2,420	.....	24,500	15,650
Chile	1906	2,477,064	*j* 124,657	698,880	*k* 27,936	2,405,584	287,612
Colombia	.....	2,800,000	.....	341,000	257,000	746,000	2,300,000
Dutch Guiana	1905	8,535	.....	230	81	138	2,662
Falkland Islands	1906	4,500	.....	3,000	.....	702,696	100

a On farms.
b Including mules and asses.
c Data for 1905.
d Cows in 1904.
e Data for 1903.
f On December 31 of preceding year.
g Cows.
h Census for 1899.
i Official estimate furnished by the French Embassy to the United States, under date of May 4, 1906.
j Data for 1904.
k Data for 1902.

Live stock of countries named—Continued.

Country.	Year.	Cattle. Total.	Cattle. Dairy cows.	Horses.	Mules.	Sheep.	Swine.
SOUTH AMERICA—cont'd.							
Paraguay	1900	2,283,039	....	182,789	3,490	214,058	23,887
Uruguay	1900	6,827,428	....	561,408	22,992	18,608,717	93,923
Venezuela	1899	2,004,257	....	191,079	89,186	176,668	1,618,214
Total South America	......	72,334,623	....	7,354,976	945,555	100,460,461	7,186,048
EUROPE.							
Austria-Hungary:							
Austria	1900	9,511,170	[a] 4,749,152	1,716,488	20,323	2,621,026	4,682,654
Hungary	1895	6,605,365	[b] 3,499,724	2,308,457	1,911	8,122,682	7,330,343
Bosnia-Herzegovina	1895	[c] 1,417,341	....	[d] 239,626	....	3,230,720	662,242
Total Austria-Hungary	......	17,533,876	....	4,264,571	22,234	13,974,428	12,675,239
Belgium	[e]1906	1,788,328	889,125	245,212	[f]6,915	[g]235,722	1,046,519
Bulgaria	1905	[h]1,596,267	[i] 442,866	536,616	11,828	8,081,816	463,241
Denmark	1903	1,840,466	[a]1,089,073	486,935	....	876,830	1,456,699
Faroe Islands	1903	3,950	....	632	....	91,034	15
Finland	1905	1,480,692	[a]1,097,198	323,514	....	937,565	220,357
France	[e]1906	14,315,552	[a]7,515,564	3,169,224	198,865	17,783,209	7,558,779
Germany	1904	19,331,568	[a]10,456,137	4,267,403	....	7,907,173	18,920,666
Gibraltar	1905	....	....	400	....	....	....
Greece	1902	406,744	....	159,068	88,869	4,568,158	79,716
Iceland	1904	30,498	....	47,545	....	[j] 495,170	....
Italy	1905	5,672,000	....	804,913	341,910	[k]10,877,000	2,224,000
Luxemburg	1901	92,381	....	19,777	[l] 10	16,611	91,799
Malta	1907	6,022	....	3,669	3,302	19,901	5,132
Montenegro	......	60,000	[a] 20,000	3,000	....	400,000	8,000
Netherlands	1904	1,690,463	[m] 973,098	295,277	....	606,785	861,840
Norway	1900	950,201	[a] 689,563	172,999	....	998,819	165,348
Portugal	......	817,000	....	90,000	59,100	3,064,100	1,200,000
Roumania	1900	2,545,051	380,720	864,324	515	5,655,444	1,709,205
Russia:							
Russia proper	1906	31,994,849	....	21,260,061	....	[n] 49,114,500	10,372,036
Poland	1906	2,414,618	....	1,309,640	....	[n] 2,817,000	800,470
Northern Caucasia	1906	3,157,358	....	1,265,100	....	[k] 6,957,954	698,335
Total Russia, European	......	37,566,825	....	23,834,801	....	58,889,454	11,870,841
Servia	[e]1906	943,967	[h] 153,359	172,278	130	3,066,444	875,517
Spain	1905	2,075,142	....	498,157	767,570	13,025,512	1,743,863
Sweden	1905	2,549,928	[a]1,763,857	554,999	....	1,074,386	829,888
Switzerland	1906	1,497,904	[a] 785,577	135,091	3,136	209,243	548,355
Turkey	......	1,000,000	[a] 300,000	600,000	....	10,000,000	....
United Kingdom:							
Great Britain	1907	6,912,067	[o] 2,759,246	[p] 1,556,369	....	26,115,455	2,636,766
Ireland	1907	4,674,834	[o] 1,560,801	[p] 523,007	....	3,815,995	1,316,729
Isle of Man and Channel Islands	1907	41,582	[o] 18,039	[p] 9,556	....	79,769	13,329
Total United Kingdom	......	11,628,483	4,338,086	2,088,932	....	30,011,219	3,966,824
Total Europe	......	127,423,308	....	43,639,337	1,504,384	192,866,023	68,521,843

[a] Cows.
[b] Cows over 1 year old, including buffalo cows.
[c] Including buffaloes.
[d] Including mules and asses.
[e] On December 31 of preceding year.
[f] Including asses; data for 1895.
[g] Data for 1895.
[h] Census, December 31, 1900.
[i] Cows, census, December 31, 1900.
[j] Excluding lambs.
[k] Including goats.
[l] Including asses.
[m] Including cows kept for breeding purposes.
[n] Data for 1905.
[o] Cows and heifers in milk and with calf.
[p] Used for agriculture and also unbroken.

Live stock of countries named—Continued.

Country.	Year.	Cattle.		Horses.	Mules.	Sheep.	Swine.
		Total.	Dairy cows.				
ASIA.							
British India [a]	1906	[b] 89,033,810	[c] 26,223,557	1,445,069	55,684	[d] 21,554,456	....
Ceylon	1906	1,542,909	....	3,743	....	95,389	99,495
Cochin China	1903	109,000	....	11,243	....	....	709,400
Cyprus	1907	55,282	....	[e] 59,645	....	[f] 258,959	45,688
Hongkong	1906	1,077	....	175	....	3	....
Japanese Empire:							
Japan	[g] 1906	1,171,074	33,154	1,372,422	....	3,590	228,204
Formosa	[g] 1905	98,528	[c] 39,295	68	....	....	976,327
Total Japanese Empire	......	1,269,602	72,449	1,372,490	....	3,590	1,204,531
Java	1900	2,654,809	....	418,400	....	....	....
Labuan	1906	2,000	....	....	....	....	....
Philippine Islands	1903	127,559	....	144,171	290	30,428	1,179,371
Russia:							
Central Asia (4 provinces)	1906	1,813,653	....	1,909,391	....	[h] 9,113,000	87,842
Siberia (4 provinces)	1906	3,798,010	....	3,032,863	....	[h] 3,773,000	767,079
Transcaucasia	1902	2,304,977	....	388,936	....	6,302,258	309,479
Other	1903	2,343,000	....	1,624,000	....	5,443,000	186,400
Total Russia, Asiatic	......	10,259,640	....	6,955,190	....	24,631,258	1,350,800
Siam	......	1,104,751	....	35,812	....	....	....
Straits Settlements	1906	29,331	....	3,513	....	1,707	[i] 102,000
Turkey, Asiatic	......	3,000,000	....	800,000	....	45,000,000	....
Total Asia	......	109,189,770	....	11,249,451	55,974	91,575,790	4,691,285
AFRICA.							
Algeria	1906	1,064,685	....	226,152	171,608	8,801,117	96,012
Basutoland	1904	213,361	....	64,621	[j] 26	[j] 2,794	[j] 476
British Central Africa	1907	48,877	....	19	22	14,697	2,177
British East Africa	1905	297,000	....	[k] 186	....	2,100,000	....
Cape of Good Hope	1904	1,954,390	540,310	255,060	64,433	[l] 14,848,795	385,945
Egypt	1900	350,000	....	80,000	10,000	....	....
German East Africa	1905	523,052	....	73	79	1,560,000	1,447
German Southwest Africa	1907	52,189	[c] 18,471	2,141	1,234	111,595	1,202
Madagascar [m]	1905	2,867,612	[c] 1,118,162	1,074	464	333,454	522,021
Mauritius [n]	1906	10,177	....	636	[o] 264	1,110	4,565
Mayotte	(*p*)	47,894	....	21	15	124	....
Natal	1906	634,547	[c] 252,496	50,240	2,206	800,090	71,764
Orange River Colony	1905	525,372	....	93,984	....	4,194,247	134,782
Reunion	(*p*)	4,720	....	1,780	4,534	4,583	....
St. Helena	1901	1,014	....	120	....	2,094	280
Seychelles	1906	1,000	....	150	....	200	6,000
Sierra Leone	1906	1,055	....	39	....	463	183
Southern Nigeria Colony (Lagos)	1902	1,522	....	108	....	1,610	2,426
Sudan (Anglo-Egyptian) [q]	1905	314,996	....	9,314	....	1,421,721	....
Transvaal	1905	800,000	350,000	[i] 52,159	[i] 44,153	1,200,000	400,000
Tunis	[g] 1905	183,748	....	35,596	15,995	1,094,761	15,357
Total Africa	......	9,897,211	....	873,473	315,033	36,493,455	1,644,637

[a] Including Native States, as far as officially shown. Statistics cover only 7 districts of Bengal, collected between 1890 and 1900.

[b] Including buffalo calves.

[c] Cows.

[d] Of which 373,003 in Alwar include goats.

[e] Including mules and asses.

[f] Not less than 1 year old; 30 per cent may be added for those less than 1 year old.

[g] On December 31 of preceding year.

[h] Data for 1903.

[i] Data for 1904.

[j] Excluding animals owned by natives.

[k] Excluding the province of Jubaland.

[l] Data for 1906.

[m] Not including animals in the public service.

[n] On sugar estates only.

[o] Including asses; data for 1905.

[p] Official estimate furnished by the French Embassy to the United States, under date of May 4, 1906.

[q] Animals assessed for tribute and tax.

Live stock of countries named—Continued.

Country.	Year.	Cattle. Total.	Cattle. Dairy cows.	Horses.	Mules.	Sheep.	Swine.
OCEANIA.							
Australia:							
Queensland	[a]1907	3,413,919	....	452,916	....	14,886,438	138,282
New South Wales	[a]1907	2,549,944	[b]644,164	537,444	....	44,132,421	243,370
Victoria	1907	1,804,323	701,309	406,840	....	12,937,440	220,452
South Australia	1907	680,095	[c]93,069	224,447	....	6,661,217	112,277
Western Australia	[a]1907	690,011	[d]27,724	104,922	[e]840	3,340,745	56,203
Tasmania	1907	211,117	....	38,299	....	1,729,394	42,985
Total Australia	......	9,349,409	....	1,764,868	840	83,687,655	813,569
British New Guinea	1906	450	....	100	....	....	....
Fiji	1906	34,793	....	[f]5,031	....	1,595	4,260
New Caledonia	(g)	73,862	....	2,938	12	9,442	2,438
New Zealand [h]	1906	1,851,750	543,927	342,608	[i]451	20,108,471	242,273
Total Oceania	......	11,310,264	1,366,029	2,115,545	1,303	103,807,163	1,062,540
Grand total	......	420,552,211	....	91,658,670	7,284,604	586,827,485	145,374,934

[a] On December 31 of preceding year.
[b] Data for 1906.
[c] Not including northern territory; data for 1906.
[d] Data for 1905.
[e] Including asses; data for 1905.
[f] Including mules and asses.
[g] Official estimate furnished by the French Embassy to the United States, under date of May 4, 1906.
[h] Including animals owned by Maoris.
[i] Including asses.

Country.	Year.	Asses.	Buffaloes.	Camels.	Goats.	Reindeer
NORTH AMERICA.						
United States:						
Contiguous—						
On farms	1900	94,165	....	....	1,870,599	....
Not on farms	1900	15,847	....	....	78,353	....
Noncontiguous—						
Hawaii [a]	1900	1,438	....	....	653	....
Porto Rico	1899	1,085	....	....	15,991	....
Total United States (except Philippine Islands)	......	112,535	....	....	1,965,596	....
Central America:						
Costa Rica	1905	100	....	....	906	....
Panama	1906	47	....	....	1,989	....
Mexico	1902	287,991	....	....	4,206,011	....
Newfoundland	1901	....	....	....	17,355	....
West Indies:						
British—Jamaica	1904	....	....	....	14,000	....
Cuba	[b]1906	2,530	....	....	[c]18,564	....
Dutch	1905	4,861	....	....	54,655	....
Guadeloupe	(d)	4,394	....	....	13,902	....
Total North America	......	412,458	....	....	6,292,978	....
SOUTH AMERICA.						
Argentina	1907	....	....	....	1,566,300	....
British Guiana	1906	....	....	....	15,500	....
Chile	1906	[e]17,574	....	....	461,908	....
Colombia	......	....	....	....	361,000	....
Dutch Guiana	1905	568	....	....	1,807	....
Paraguay	1900	4,067	....	....	32,334	....
Uruguay	1900	....	....	....	20,428	....
Venezuela	1899	312,810	....	....	1,667,272	....
Total South America	......	335,019	....	....	4,126,549	....

[a] On farms.
[b] On December 31 of preceding year.
[c] Census for 1899.
[d] Official estimate furnished by the French Embassy to the United States under date of May 4, 1906.
[e] Data for 1902.

Live stock of countries named—Continued.

Country.	Year.	Asses.	Buffaloes.	Camels.	Goats.	Reindeer.
EUROPE.						
Austria-Hungary:						
Austria	1900	46,324			1,019,664	
Hungary	1895	23,855	133,000		308,810	
Bosnia-Herzegovina	1895				1,447,049	
Total Austria-Hungary		70,179	133,000		2,775,523	
Belgium	a1905				257,669	
Bulgaria	1905	124,216	b 431,487		1,370,201	
Denmark	1903				38,984	
Faroe Islands	1903				10	
Finland	1905				6,276	141,811
France	a1906	365,181			1,476,957	
Germany	1904				3,329,881	
Greece	1902	141,179			3,339,409	
Iceland	1904				401	
Italy	1890	1,000,000			1,800,000	
Luxemburg	1901				14,203	
Malta	1907	3,905			19,231	
Montenegro					100,000	
Netherlands	1904				165,497	
Norway	1900				214,594	108,784
Portugal		146,500			998,680	
Roumania	1900	7,186	43,475		232,515	
Russia:						
Russia proper	1905			224,500	1,100,500	347,000
Poland				1,000	13,500	
Total Russia, European				225,500	1,114,000	347,000
Servia	a1906	1,271	7,710		495,955	
Spain	1905	663,004		1,800	2,385,664	
Sweden	1905				66,560	
Switzerland	1906	1,652			359,913	
Total Europe		2,524,273	615,672	227,300	20,562,123	597,595
ASIA.						
British India c	1906	d 1,336,868	14,914,554	435,930	28,555,809	
Ceylon	1905				148,288	
Cochin China	1903		241,750			
Cyprus	1906			1,169	e 250,546	
Hongkong	1905				160	
Japanese Empire:						
Japan	a1906				72,121	
Formosa	a1905		226,620		117,214	
Total Japanese Empire			226,620		189,335	
Java	1900		2,436,031			
Philippine Islands	1903		f 640,871		124,334	
Russia:						
Central Asia (4 provinces)	1903			365,000	775,000	
Siberia (4 provinces)	1903			500	230,000	38,700
Transcaucasia	1902	122,312	338,042	17,122	745,086	
Other	1903	58,500		296,000	802,000	20,000
Total Russia, Asiatic		180,812	338,042	678,622	2,552,086	58,700
Siam g			1,144,478			
Turkey, Asiatic		2,500,000			9,000,000	
Total Asia		4,017,680	19,942,346	1,115,721	40,820,558	58,700
AFRICA.						
Algeria	1906	287,950		201,752	3,959,854	
Basutoland	1904	h 10			h 1,625	
British Central Africa	1907	190	8		78,511	
British East Africa	1906				1,150,000	
Cape of Good Hope	1904	100,470			i 7,826,965	

a On December 31 of preceding year.
b Census data December 31, 1900.
c Including Native States, as far as officially shown. Statistics cover only 7 districts of Bengal, collected between 1890 and 1900.
d Of which 58,663 in Bengal, Alwar, Gwalior, and Marwar includes mules.
e Not less than 1 year old; 30 per cent may be added for those less than 1 year old.
f Carabaos.
g Number of domesticated elephants returned as 2,036.
h Excluding animals owned by natives.
i Data for 1906.

Live stock of countries named—Continued.

Country.	Year.	Asses.	Buffaloes.	Camels.	Goats.	Reindeer.
AFRICA—continued.						
Egypt	1900	120,000	300,000	40,000	....	....
German East Africa	1905	8,777	....	24	1,820,000	....
German Southwest Africa	1907	1,630	....	28	103,259	....
Madagascar[a]	1905	411	....	....	66,747	....
Mauritius[b]	1905	....	....	....	6,348	....
Mayotte	(c)	58	....	....	1,508	....
Natal	1906	1,759	....	....	724,428	....
Orange River Colony	1903	3,096	....	....	308,920	....
Reunion	(c)	1,916	....	....	4,156	....
St. Helena	1901	774	....	....	1,001	....
Southern Nigeria Colony (Lagos)	1902	....	....	....	2,600	....
Sudan (Anglo-Egyptian)[d]	1905	[e] 92,272	....	132,116	1,329,711	....
Transvaal	1904	33,013	....	....	949,876	....
Tunis	[f]1905	97,990	....	147,229	574,281	....
Total Africa	......	750,316	300,008	521,149	18,909,790	....
OCEANIA.						
Australia:						
New South Wales	[f]1905	....	....	853	37,716	....
South Australia	1905	....	....	....	26,948	....
Western Australia	[f]1905	....	....	1,953	17,980	....
Tasmania	1905	....	....	....	1,694	....
Total Australia	......	....	....	2,806	84,338	....
Fiji	1905	....	....	....	16,782	....
New Caledonia	(c)	....	....	....	6,111	....
New Zealand[g]	1891	....	....	....	9,055	....
Total Oceania	......	....	....	2,806	116,286	....
Grand total	......	8,039,746	20,858,026	1,866,976	90,828,284	656,295

[a] Not including animals in the public service.
[b] On sugar estates only.
[c] Official estimate furnished by the French Embassy to the United States under date of May 4, 1906.
[d] Animals assessed for tribute and tax.
[e] Including mules.
[f] On December 31 of preceding year.
[g] Including animals owned by Maoris.

International trade in hides and skins.[a]

[Substantially the international trade of the world. This table gives the classification as found in the original returns, and the summary statements for "All countries" represent the total for each class only as far as it is disclosed in the original returns.]

EXPORTS.

Country.	Year beginning—	Kind of hides and skins.	1902.	1903.	1904.	1905.	1906.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	Jan. 1	Cattle, dried	58,550,351	51,239,825	50,466,002	53,457,674	51,149,435
		do., salted	77,917,955	63,424,770	64,809,273	90,239,588	72,476,948
		Goat	3,025,215	3,113,899	3,961,693	4,205,350	4,164,487
		Horse, dried	4,354,053	2,870,826	2,152,791	2,801,828	680,007
		do., salted	4,187,878	4,921,984	4,591,961	1,731,726	3,507,399
		Kid	1,075,505	815,695	1,049,508	971,729	944,222
		Sheep	91,282,374	92,442,005	81,571,014	66,535,492	52,428,116
Austria-Hungary	Jan. 1	Calf, dried	8,363,895	6,681,327	6,139,211	6,855,933	12,382,700
		do., salted	3,299,437	5,505,382	6,623,787	9,100,680	
		Cattle, dried	7,717,941	6,801,038	6,274,354	5,676,240	16,000,926
		do., salted	10,025,959	12,569,873	9,172,109	13,682,766	
		Goat	2,079,840	2,004,442	2,542,591	1,977,987	2,542,150
		Horse, dried	1,802,940	1,313,514	1,033,747	2,297,437	5,281,392
		do., salted	869,062	2,162,293	2,495,853	3,808,485	
		Kid	1,362,015	1,431,241	2,120,626	1,836,009	[b] 1,836,009
		Lamb	5,084,079	4,232,874	3,187,442	3,535,111	3,518,356
		Sheep	3,073,243	4,034,017	3,575,676	4,251,393	5,056,962
Belgium	Jan. 1	Hides and skins	90,233,439	91,087,316	90,367,454	101,081,934	102,400,208
Brazil	Jan. 1	Deer	339,935	265,401	262,167	176,295	....
		Goat	3,271,247	4,193,246	5,556,633	3,361,740	3,842,815
		Hides, dried, n. e. s.[c]	14,334,210	16,401,080	23,845,672	17,328,272	21,667,230
		do., salted, n. e. s.[c]	44,873,097	46,006,347	48,004,782	42,135,260	50,567,124
		Horse	(d)	88,194	245,716	28,936	18,660
		Lamb	33,881	67,298	289,196	5,143	64,218
		Sheep	615,134	598,573	1,042,429	959,755	869,285
		Other	8,426	9,262	28,911	33,113	....
British India	Apr. 1	Hides and skins	102,390,604	104,922,115	120,635,178	166,161,155	174,292,118
Canada[e]	July 1	Hides and skins	23,096,000	23,647,000	29,418,000	31,760,000	33,019,183
Cape of Good Hope	Jan. 1	Calf	13,710	69,317	90,391	96,562	....
		Cattle	2,587,990	1,189,172	2,049,386	2,970,438	2,884,161
		Goat	4,491,204	5,217,449	4,928,951	5,461,295	18,750,766
		Sheep	14,204,556	12,602,310	11,602,058	11,713,890	
		Hides, n. e. s.[c]	13,940	8,545	637	....	....
China	Jan. 1	Hides	39,360,667	32,309,600	37,330,133	51,043,990	56,615,924
Cuba	Jan. 1	Cattle	3,605,188	2,351,012	2,438,844	4,622,643	6,957,223
		Other	10,453	84,032	52,482	198,299	207,823
Denmark	Jan. 1	Hides and skins	14,895,515	15,520,748	16,166,351	19,345,629	18,442,353
Dutch East Indes	Jan. 1	Hides and skins	13,530,863	13,729,290	13,940,625	14,039,571	[b] 14,039,571

Egypt	Jan. 1	Cattle and calf	4,337,137	4,331,513	6,841,357	4,547,315	5,748,384
		Sheep and goat [f]	681,118	697,529	1,084,797	2,620,849	5,075,462
France	Jan. 1	Calf	(d)	(d)	21,348,790	17,430,187	23,497,700
		Goat	(d)	(d)	7,613,556	10,333,449	8,400,500
		Kid	1,014,770	1,198,100	875,649	626,944	937,800
		Lamb	903,981	1,146,708	1,096,486	1,446,190	1,325,000
		Large	61,585,683	48,863,350	53,066,971	61,880,962	69,136,300
		Sheep	9,624,639	8,517,409	9,047,394	10,009,143	11,967,300
		Other	27,562,511	27,052,872	3,035,932	7,776,412	6,723,900
Germany [g]	Jan. 1	Calf, green	10,596,516	9,076,870	8,618,308	10,235,619	15,596,157
		do., dried	11,096,965	7,410,396	9,228,989	9,504,125	1,269,421
		Cattle, green	73,594,692	65,404,300	65,279,298	65,859,114	78,564,351
		do., dried	10,400,084	9,406,240	9,416,161	11,561,258	1,870,181
		Goat, with hair on	3,516,593	3,350,364	4,021,451	3,744,110	3,162,310
		do., without hair	11,023	12,566	15,432	19,401	36,597
		Horse, green	9,690,416	10,715,124	8,345,156	16,149,958	17,739,050
		do., dried	1,488,561	1,711,448	1,782,878	1,029,216	316,804
		Sheep	585,548	811,521	385,147	823,206	137,568
		Other	711,432	607,814	698,865	604,507	610,235
Italy	Jan. 1	Cattle and calf	20,757,839	24,070,283	23,639,941	19,357,463	25,858,232
		Sheep and goat	4,583,409	4,329,437	4,125,950	4,616,038	4,502,500
		Other	571,658	765,665	695,338	2,737,700	910,729
Korea	Jan. 1	Cattle	3,981,600	5,525,600	4,755,600	2,273,200	2,209,733
		Skins	3,954,667	5,421,200	4,660,533	5,507,867	[b] 5,507,867
Mexico	July 1	Alligator	343,013	263,545	176,853	131,074	147,093
		Cattle	14,808,550	11,692,993	13,122,915	15,690,473	19,715,538
		Deer	728,398	627,292	583,367	636,765	843,980
		Goat	6,518,637	5,798,853	5,934,593	7,098,634	7,705,458
		Horse	41,213	35,020	28,418	50,243	....
		Sheep	2,273	2,657	1,466	16,885	27,655
Netherlands	Jan. 1	Hides, dried	20,012,580	20,607,052	23,647,466	22,724,931	24,050,349
		do., fresh	271,541	414,482	301,548	236,435	237,965
		do., salted	32,387,467	33,893,118	31,865,968	32,383,298	34,507,035
		Sheep	3,227,362	2,309,591	2,708,125	1,664,492	1,322,985
New Zealand	Jan. 1	Calf [e]	50,152	23,136	29,862	103,286	276,056
		Hides [e]	855,722	1,013,593	1,041,637	1,926,182	2,554,873
		Sheep	13,795,190	15,074,406	12,833,612	12,599,222	14,364,574
Peru	Jan. 1	Hides and skins	5,324,480	6,009,920	6,717,760	6,954,866	[b] 6,954,866
Russia	Jan. 1	Hides, large	9,601,743	12,774,759	16,666,202	14,284,165	[h] 31,093,121
		do., small	19,764,247	19,949,000	24,406,908	24,540,778	[h] 26,326,231
		Sheep and goats	15,289,329	17,884,900	22,220,675	19,206,232	[h] 35,462,770
Singapore	Jan. 1	Hides	6,216,267	8,694,400	6,919,733	7,268,133	[b] 7,268,133
Spain	Jan. 1	Goat	3,158,648	2,628,269	2,014,515	1,748,702	1,017,973
		Sheep	5,714,217	5,210,152	6,305,843	8,383,804	8,042,360
		Other	2,355,431	4,248,659	5,965,921	9,359,902	12,536,488
Sweden	Jan. 1	Hides and skins	11,427,951	13,025,348	12,647,729	15,709,468	16,247,694
Switzerland	Jan. 1	Hides	12,836,632	12,201,260	11,750,194	12,095,438	13,414,023
		Skins	4,976,493	5,041,530	5,544,404	6,062,490	5,744,584

[a] See "General note," p. 615.
[b] Year preceding.
[c] N. e. s.=not elsewhere specified.
[d] Not separately stated.
[e] Estimated.
[f] Number of pounds computed from stated number of hides or skins.
[g] Not including free ports prior to March 1, 1906.
[h] Preliminary.

International trade in hides and skins—Continued.

Country.	Year beginning—	Kind of hides and skins.	1902.	1903.	1904.	1905.	1906.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United Kingdom	Jan. 1	Hides	21,075,264	17,451,168	21,128,464	29,427,328	31,359,776
		Skins [a]	32,681,620	44,795,145	49,864,593	46,964,937	37,835,419
United States	July 1	Hides and skins	12,859,549	32,727,643	10,268,722	10,752,827	15,396,806
Uruguay	July 1	Calf	2,083,720	2,967,990	2,074,655	1,795,344	[b] 1,795,344
		Cattle, dried	22,575,437	15,019,462	13,852,273	14,056,903	[b] 14,056,903
		do., salted [a]	33,994,970	35,823,436	41,159,472	30,875,494	[b] 30,875,494
		Goat	1,277	1,414	9,539	34	[b] 34
		Horse, dried [a]	483,696	397,568	1,607,872	515,104	[b] 515,104
		do., salted [a]	1,946,505	1,751,352	504,196	124,608	[b] 124,608
		Lamb	358,738	608,383	406,598	346,719	[b] 346,719
		Sheep	14,670,201	19,397,852	16,033,901	14,990,823	[b] 14,990,823
Venezuela	July 1	Cattle	4,346,829	8,366,624	[c] 6,356,726	7,929,730	[b] 7,929,730
		Deer	100,654			349,459	[b] 349,459
		Goat	1,412,091	1,650,675	[c] 1,531,383	1,479,815	[b] 1,479,815
		Sheep	28,997				
Other countries		Hides:					
		Cattle	16,437,548	17,486,222	12,706,880	46,832,873	[d] 46,343,144
		Horse	33,486	80,026	348,784	471,232	[d] 384,143
		Large (not otherwise classified)	1,611,336	3,148,588	6,198,614	303,172	[d] 245,841
		Small (not otherwise classified)	501,523	1,352,037	1,915,667		
		Unclassified	14,424,497	14,085,945	8,906,979	14,384,816	[d] 20,335,396
		Skins:					
		Calf	2,392,438	1,799,084	2,183,255	2,435,640	[d] 2,448,174
		Deer	1,745,289	1,303,750	1,372,926	859,467	
		Goat	3,948,484	6,536,130	4,427,066	8,010,735	[d] 4,897,210
		Kid	66,932	21,786	40,836	1,040,412	[d] 1,634,845
		Sheep	3,173,604	3,313,301	2,942,913	11,014,904	[d] 12,771,969
		Sheep and goat, mixed	7,500,393	6,048,093	8,084,693	19,280,233	[d] 17,082,052
		Unclassified	147,072	73,145	66,311	5,805,481	[d] 1,381,611
		Hides and skins, unclassified	5,471,773	6,441,858	5,393,110	8,597,283	[d] 7,849,669
Total			1,313,009,102	1,318,431,233	1,342,565,755	1,516,304,852	1,570,003,744

RECAPITULATION.							
All countries		Hides:					
		Cattle	340,545,094	306,300,567	301,859,293	365,728,394	351,033,767
		Cattle and calf, mixed	25,094,976	28,401,796	30,481,298	23,904,778	31,606,616
		Horse	24,897,810	26,047,349	23,137,372	29,608,773	28,567,167
		Large (not otherwise classified)	72,798,762	64,786,697	75,931,787	76,468,299	100,475,262
		Small (not otherwise classified)	20,265,770	21,301,037	26,322,575	24,540,778	26,326,231
		Unclassified	206,661,884	203,086,590	214,743,213	230,954,083	261,949,137
		Skins:					
		Alligator	343,013	263,545	176,853	131,074	147,093
		Calf	37,896,833	33,533,502	56,337,248	57,557,376	57,265,552
		Deer	2,909,276	2,196,443	2,218,460	2,021,986	1,193,439
		Goat	31,434,259	34,507,307	42,557,403	47,441,252	37,249,349
		Kid	3,519,222	3,466,822	3,210,970	4,475,094	5,352,876
		Lamb	6,380,679	6,055,263	5,855,371	5,333,163	5,254,293
		Sheep	159,997,338	164,313,794	148,049,578	142,963,009	121,979,597
		Sheep and goat, mixed	28,054,249	28,959,959	35,516,115	45,723,352	80,873,550
		Unclassified	41,759,852	55,331,020	60,135,841	64,340,775	50,469,481
		Hides and skins, unclassified	310,450,085	339,879,542	316,032,378	395,112,666	410,260,334
Total			1,313,009,102	1,318,431,233	1,342,565,755	1,516,304,852	1,570,003,744

IMPORTS.

Austria-Hungary	Jan. 1	Calf, dried	942,035	1,245,171	1,496,718	1,056,896	3,415,400
		do., green	1,066,155	1,716,078	1,449,759	994,505	
		Cattle, dried	22,938,651	22,300,192	29,398,855	25,180,311	75,516,461
		do., green	18,459,961	18,503,392	27,347,454	17,540,414	
		Goat	1,027,354	1,100,547	1,588,430	1,410,076	1,243,407
		Horse, dried	679,685	583,784	560,856	360,676	992,521
		do., green	75,178	125,223	153,662	224,871	
		Kid	776,688	844,591	1,046,093	723,557	[b] 723,557
		Lamb	9,869,872	9,627,600	10,328,434	8,602,435	10,548,675
		Sheep	5,477,163	5,391,403	5,041,309	5,061,592	6,856,374
Belgium	Jan. 1	Hides, raw	115,127,382	128,694,622	122,539,211	135,911,437	142,197,407
British India	Apr. 1	Hides and skins	10,407,488	12,729,808	12,456,304	17,574,316	17,962,909
Denmark	Jan. 1	Hides and skins	8,013,801	5,766,189	6,962,196	7,848,454	10,294,482
Finland	Jan. 1	Hides, dried	714,805	1,560,180	1,869,515	1,898,433	2,631,124
		do., green	3,789,873	5,907,507	5,780,115	4,263,421	5,529,891
		Sheep	23,420	45,380	89,521	56,061	68,050
France	Jan. 1	Calf	(e)	(e)	7,090,958	7,980,756	9,035,400
		Goat	(e)	(e)	17,899,172	23,110,243	23,276,400
		Kid	5,300,740	4,714,701	4,372,843	4,544,123	4,935,700
		Lamb	212.442	441,758	370,533	378,553	374,600
		Large	80,509,184	89,049,162	85,214,688	98,515,340	106,831,100
		Sheep	3,848,128	3,032,612	2,630,226	2,532,200	3,201,300
		Other	28,625,723	28,990,427	2,063,720	3,209,189	1,674,900

[a] Number of pounds computed from stated number of hides or skins. [b] Year preceding. [c] Average, 1902 and 1903. [d] Preliminary. [e] Not separately stated.

International trade in hides and skins—Continued.

Country.	Year beginning—	Kind of hides and skins.	1902.	1903.	1904.	1905.	1906.
			Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Germany [a]	Jan. 1	Calf, dried	23,886,198	18,793,521	21,104,405	22,145,869	18,811,819
		do., green	16,023,193	22,039,386	24,738,945	32,244,140	38,531,942
		Cattle, dried	46,048,822	60,664,363	63,954,541	70,228,234	77,797,583
		do., green	122,198,450	146,242,719	152,057,850	143,851,586	177,694,958
		Goat, with hair on	8,591,191	9,266,908	11,272,453	11,042,952	14,541,907
		do., without hair	153,001	25,794	61,068	38,140	1,543
		Horse, dried	3,721,181	4,427,101	4,666,964	4,592,889	6,688,823
		do., green	28,144,866	30,128,805	27,629,866	25,891,742	30,573,918
		Sheep	562,840	737,005	1,126,562	746,485	882,510
		Other	2,207,268	3,032,017	3,515,711	3,340,443	2,157,002
Greece	Jan. 1	Hides	5,565,407	5,674,975	7,004,659	6,055,809	5,286,284
Italy	Jan. 1	Cattle and calf	33,054,118	32,555,653	42,876,591	39,240,949	44,294,383
		Sheep and goat	9,236,484	9,197,903	9,997,520	8,740,884	11,596,532
		Other	287,703	136,687	89,287	181,881	277,782
Japan	Jan. 1	Cattle	4,395,787	4,516,054	9,871,720	7,402,046	5,450,564
		Deer	353,188	437,982	373,908	426,217	700,708
Netherlands	Jan. 1	Hides, dried	26,123,959	28,746,002	28,190,550	29,700,509	30,643,584
		do., fresh	14,218	3,486	1,080	15,141	5,404
		do., salted	21,767,787	24,734,682	25,207,165	21,586,003	27,913,694
		Sheep	2,578,768	1,631,356	2,084,239	2,367,808	2,094,329
Norway	Jan. 1	Hides and skins	5,880,102	5,555,934	6,890,458	8,722,279	10,507,626
Portugal	Jan. 1	Hides, dried	6,659,709	6,188,733	5,829,003	4,216,487	[b] 4,216,487
		do., green	1,455,366	507,616	243,906	181,630	[b] 181,630
		do., n. e. s.	2,222	990	825	414	[b] 414
Roumania	Jan. 1	Buffalo	422,935	160,214	39,361	83,987	[b] 83,987
		Calf	29,674	65,731	13,406	13,728	[b] 13,728
		Cattle	5,045,606	3,468,799	2,444,346	2,252,952	[b] 2,252,952
		Horse	2,491	8,014	22	3,490	[b] 3,490
		Sheep, lamb, and goat	722,428	610,125	400,000	157,536	[b] 157,536
		Other	820,025	158,376	163,773	132,822	[b] 132,822
Russia	Jan. 1	Hides, dry	12,831,961	12,279,363	10,412,368	12,668,515	[c] 7,764,252
		do., green	52,627,183	55,754,913	48,126,842	51,753,326	[c] 45,538,241
Singapore	Jan. 1	Hides	10,275,333	10,258,000	10,554,133	8,191,200	[b] 8,191,200
Spain	Jan. 1	Hides and skins	25,794,130	22,716,150	17,857,559	14,247,484	17,280,965
Sweden	Jan. 1	Hides and skins	15,676,710	15,172,306	19,782,796	18,939,762	21,290,081
United Kingdom	Jan. 1	Goat [d]	3,546,428	3,557,151	5,517,464	3,756,596	9,329,915
		Hides	73,656,912	62,491,856	61,636,848	60,628,848	70,661,696
		Sheep [d]	44,636,946	44,909,414	34,490,368	34,694,106	42,124,265
		Other	1,054,534	3,124,408	1,386,550	377,900	782,536
United States	July 1	Cattle	131,640,325	85,370,168	113,177,357	156,155,300	134,671,020
		Goat	85,114,070	86,338,547	97,803,571	111,079,391	101,201,596
		Other	102,340,303	103,024,752	126,893,934	158,045,419	135,111,199

Other countries		Hides:					
		Cattle	5,100,292	5,441,221	7,289,141	7,143,387	c 3,467,039
		Large (not otherwise classified)	412,785	438,504	1,054,916	328,180	c 5,190
		Small (not otherwise classified)	1,499	7,011	17,289	9,368,570	c 14,679,557
		Unclassified	5,590,463	8,100,685	4,932,465		
		Skins:					
		Calf	135,079	13,933	153,261	128,604	
		Deer	5,670	9,886	21,014		
		Goat	142,253	423,808	452,838	665,581	c 127,892
		Sheep	397,783	1,533,850	1,534,647	741,964	c 646,355
		Sheep and goat, mixed	25,854	22,447	10,416	3,849	c 61,619
		Unclassified	1,249,139	1,348,347	1,277,800	2,003,073	c 1,850,918
		Hides and skins, unclassified	2,365,315	3,330,259	1,321,133	839,318	c 903,410
Total			1,268,461,682	1,287,754,237	1,365,305,461	1,466,343,284	1,556,494,545
RECAPITULATION.							
All countries		Hides:					
		Buffalo	422,935	160,214	39,361	83,987	b 83,987
		Cattle	355,827,894	346,506,908	405,541,264	429,754,230	476,850,577
		Cattle and calf, mixed	33,054,118	32,555,653	42,876,591	39,240,949	44,294,383
		Horse	32,623,401	35,272,927	33,011,370	31,073,668	38,258,752
		Large (not otherwise classified)	80,921,969	89,487,666	86,269,604	98,843,520	106,836,290
		Small (not otherwise classified)	1,499	7,011	17,289	346,439,743	365,440,865
		Unclassified	336,202,580	350,903,610	332,328,685		
		Skins:					
		Calf	42,082,334	43,873,820	56,047,447	64,564,498	69,808,289
		Deer	353,188	437,982	373,908	426,217	700,708
		Goat	98,574,297	100,712,755	134,594,996	151,102,979	149,722,660
		Kid	6,077,428	5,559,292	5,418,936	5,267,680	5,659,257
		Lamb	10,082,314	10,069,358	10,698,967	8,980,988	10,923,275
		Sheep	57,525,048	57,281,020	46,996,872	46,200,216	55,873,183
		Sheep and goat, mixed	9,984,766	9,830,475	10,407,936	8,902,269	11,815,687
		Unclassified	1,249,139	1,348,347	1,277,800	2,003,073	1,850,918
		Hides and skins, unclassified	203,473,102	203,737,313	199,383,421	233,459,267	218,375,714
Total			1,268,461,682	1,287,754,237	1,365,305,461	1,466,343,284	1,556,494,545

a Not including free ports prior to March 1, 1906. b Year preceding. c Preliminary. d Number of pounds computed from stated number of hides or skins.

FARM ANIMALS AND THEIR PRODUCTS IN CONTINENTAL UNITED STATES.

HORSES AND MULES.

Number and farm value of horses and mules in the United States, 1867–1908.

January 1—	Horses.			Mules.		
	Number.	Price per head Jan. 1.	Farm value Jan. 1.	Number.	Price per head Jan. 1.	Farm value Jan. 1.
1867	5,401,263	$59.05	$318,924,085	822,386	$66.94	$55,048,257
1868	5,756,940	54.27	312,416,048	856,625	56.04	47,953,624
1869	6,332,793	62.57	396,222,359	921,662	79.23	73,026,906
1870	8,248,800	67.49	556,250,529	1,179,500	90.42	106,654,015
1871	8,702,000	71.14	619,038,564	1,242,300	91.98	114,272,194
1872	8,990,900	67.41	606,111,449	1,276,300	87.14	111,221,919
1873	9,222,470	66.39	612,273,159	1,310,000	85.15	111,546,171
1874	9,333,800	65.15	608,072,797	1,339,350	81.35	108,952,659
1875	9,504,200	61.10	580,707,854	1,393,750	71.89	100,197,044
1876	9,735,300	57.29	557,746,731	1,414,500	66.46	94,000,976
1877	10,155,400	55.83	567,016,871	1,443,500	64.07	92,481,931
1878	10,329,700	56.63	584,998,503	1,637,500	62.03	101,579,278
1879	10,938,700	52.36	572,712,085	1,713,100	56.00	95,941,589
1880	11,201,800	54.75	613,296,611	1,729,500	61.26	105,948,319
1881	11,429,626	58.44	667,954,325	1,720,731	69.79	120,096,164
1882	10,521,554	58.53	615,824,914	1,835,169	71.35	130,945,378
1883	10,838,111	70.59	765,041,308	1,871,079	79.49	148,732,390
1884	11,169,683	74.64	833,734,400	1,914,126	84.22	161,214,976
1885	11,564,572	73.70	852,282,947	1,972,569	82.38	162,497,097
1886	12,077,657	71.27	860,823,208	2,052,593	79.60	163,381,096
1887	12,496,744	72.15	901,685,755	2,117,141	78.91	167,057,538
1888	13,172,936	71.82	946,096,154	2,191,727	79.78	174,853,563
1889	13,663,294	71.89	982,194,827	2,257,574	79.49	179,444,481
1890	14,213,837	68.84	978,516,562	2,331,027	78.25	182,394,099
1891	14,056,750	67.00	941,823,222	2,296,532	77.88	178,847,370
1892	15,498,140	65.01	1,007,593,636	2,314,699	75.55	174,882,070
1893	16,206,802	61.22	992,225,185	2,331,128	70.68	164,763,751
1894	16,081,139	47.83	769,224,799	2,352,231	62.17	146,232,811
1895	15,893,318	36.29	576,730,580	2,333,108	47.55	110,927,834
1896	15,124,057	33.07	500,140,186	2,278,946	45.29	103,204,457
1897	14,364,667	31.51	452,649,396	2,215,654	41.66	92,302,090
1898	13,960,911	34.26	478,362,407	2,190,282	43.88	96,109,516
1899	13,665,307	37.40	511,074,813	2,134,213	44.96	95,963,261
1900	13,537,524	44.61	603,969,442	2,086,027	53.55	111,717,092
1901	16,744,723	52.86	885,200,168	2,864,458	63.97	183,232,209
1902	16,531,224	58.61	968,935,178	2,757,017	67.61	186,411,704
1903	16,557,373	62.25	1,030,705,959	2,728,088	72.49	197,753,327
1904	16,736,059	67.93	1,136,940,298	2,757,916	78.88	217,532,832
1905	17,057,702	70.37	1,200,310,020	2,888,710	87.18	251,840,378
1906	18,718,578	80.72	1,510,889,906	3,404,061	98.31	334,680,520
1907	19,746,583	93.51	1,846,578,412	3,816,692	112.16	428,063,613
1908	19,992,000	93.41	1,867,530,000	3,869,000	107.76	416,939,000

Imports and exports of horses and mules, with average prices, 1892–1907.

Year ending June 30—	Imports of horses.			Exports of horses.			Exports of mules.		
	Number.	Value.	Average import price.	Number.	Value.	Average export price.	Number.	Value.	Average export price.
1892	14,074	$2,455,868	$174.50	3,226	$611,188	$189.46	1,965	$238,591	$121.42
1893	15,451	2,388,267	154.57	2,967	718,607	242.20	1,634	210,278	128.69
1894	6,166	1,319,572	214.01	5,246	1,108,995	211.40	2,063	240,961	116.80
1895	13,098	1,055,191	80.56	13,984	2,209,298	157.99	2,515	186,452	74.14
1896	9,991	662,591	66.32	25,126	3,530,703	140.52	5,918	406,161	68.63
1897	6,998	464,808	66.42	39,532	4,769,265	120.64	7,473	545,331	72.97
1898	3,085	414,899	134.49	51,150	6,176,569	120.75	8,098	664,789	82.09
1899	3,042	551,050	181.15	45,778	5,444,342	118.93	6,755	516,908	76.52
1900	3,102	596,592	192.32	64,722	7,612,616	117.62	43,369	3,919,478	90.38
1901	3,785	985,738	260.43	82,250	8,873,845	107.89	34,405	3,210,267	93.31
1902	4,832	1,577,234	326.41	103,020	10,048,046	97.53	27,586	2,692,298	97.60
1903	4,999	1,536,296	307.32	34,007	3,152,159	92.69	4,294	521,725	121.47
1904	4,726	1,460,287	308.99	42,001	3,189,100	75.93	3,658	412,971	112.90
1905	5,180	1,591,083	307.16	34,822	3,175,259	91.19	5,826	645,464	110.79
1906	6,021	1,716,675	285.11	40,087	4,365,981	108.91	7,167	989,639	138.08
1907	6,080	1,978,105	325.35	32,882	4,359,957	131.99	6,781	850,901	125.48

Number, average price, and farm value of horses and mules in the United States January 1, 1908, by States.

State or Territory.	Horses.			Mules.		
	Number.	Average price per head Jan. 1.	Farm value Jan. 1.	Number	Average price per head Jan. 1.	Farm value Jan. 1.
Maine	116,000	$106.00	$12,296,000			
New Hampshire	60,000	101.00	6,060,000			
Vermont	93,000	101.00	9,393,000			
Massachusetts	81,000	111.00	8,991,000			
Rhode Island	14,000	121.00	1,694,000			
Connecticut	60,000	118.00	7,080,000			
New York	696,000	113.00	78,648,000	4,000	$122.00	$488,000
New Jersey	102,000	113.00	11,526,000	5,000	135.00	675,000
Pennsylvania	607,000	114.00	69,198,000	41,000	124.00	5,084,000
Delaware	37,000	99.00	3,663,000	6,000	125.00	750,000
Maryland	158,000	94.00	14,852,000	20,000	121.00	2,420,000
Virginia	311,000	97.00	30,167,000	51,000	124.00	6,324,000
West Virginia	189,000	102.00	19,278,000	11,000	110.00	1,210,000
North Carolina	190,000	107.00	20,330,000	177,000	126.00	22,302,000
South Carolina	84,000	118.00	9,912,000	138,000	143.00	19,734,000
Georgia	139,000	111.00	15,429,000	232,000	140.00	32,480,000
Florida	52,000	104.00	5,408,000	18,000	142.00	2,556,000
Ohio	949,000	111.00	105,339,000	20,000	110.00	2,200,000
Indiana	814,000	105.00	85,470,000	88,000	111.00	9,768,000
Illinois	1,591,000	107.00	170,237,000	143,000	113.00	16,159,000
Michigan	704,000	105.00	73,920,000	4,000	107.00	428,000
Wisconsin	643,000	105.00	67,515,000	5,000	94.00	470,000
Minnesota	723,000	98.00	70,854,000	9,000	103.00	927,000
Iowa	1,419,000	99.00	140,481,000	44,000	108.00	4,752,000
Missouri	957,000	88.00	84,216,000	321,000	101.00	32,421,000
North Dakota	616,000	97.00	59,752,000	8,000	112.00	896,000
South Dakota	560,000	86.00	48,160,000	8,000	100.00	800,000
Nebraska	1,015,000	87.00	88,305,000	68,000	102.00	6,936,000
Kansas	1,108,000	87.00	96,396,000	140,000	99.00	13,860,000
Kentucky	391,000	95.00	37,145,000	201,000	106.00	21,306,000
Tennessee	315,000	97.00	30,555,000	284,000	108.00	30,672,000
Alabama	160,000	89.00	14,240,000	234,000	113.00	26,442,000
Mississippi	260,000	77.00	20,020,000	279,000	105.00	29,295,000
Louisiana	224,000	66.00	14,784,000	168,000	109.00	18,312,000
Texas	1,278,000	65.00	83,070,000	637,000	91.00	57,967,000
Oklahoma	744,000	73.00	54,312,000	168,000	96.00	16,128,000
Arkansas	279,000	68.00	18,972,000	209,000	95.00	19,855,000
Montana	292,000	73.00	21,316,000	4,000	82.00	328,000
Wyoming	117,000	60.00	7,020,000	1,000	96.00	96,000
Colorado	262,000	71.00	18,602,000	10,000	95.00	950,000
New Mexico	118,000	42.00	4,956,000	7,000	70.00	490,000
Arizona	101,000	53.00	5,353,000	4,000	89.00	356,000
Utah	119,000	71.00	8,449,000	3,000	61.00	183,000
Nevada	102,000	77.00	7,854,000	4,000	86.00	344,000
Idaho	150,000	75.00	11,250,000	2,000	100.00	200,000
Washington	311,000	98.00	30,478,000	4,000	104.00	416,000
Oregon	285,000	96.00	27,360,000	7,000	99.00	693,000
California	396,000	94.00	37,224,000	82,000	113.00	9,266,000
United States	19,992,000	93.41	1,867,530,000	3,869,000	107.76	416,939,000

Range of prices for horses in Omaha, monthly, 1903–1907.

Date.	Draft.		General purpose.		Southern.		Western.		Drivers.		Carriage teams.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.												
January	$90	$175	$50	$80	$35	$70	$10	$50	$95	$225	$200	$350
February	95	185	60	100	35	75	10	50	95	225	200	350
March	100	200	60	110	35	70	10	50	100	230	200	400
April	100	250	60	110	30	65	10	50	100	250	200	500
May	110	250	65	105	20	55	12	60	100	350	250	550
June	90	200	65	100	15	40	12	65	100	375	300	450
July	90	175	50	80	15	45	10	65	75	275	200	400
August	90	175	45	80	15	45	10	90	75	220	210	420
September	90	175	40	80	15	45	10	100	95	200	215	360
October	100	180	40	80	20	45	10	100	90	215	200	435
November	90	160	45	85	20	60	10	80	100	325	225	370
December	100	185	45	85	20	60	12	60	100	300	200	375
1904.												
January	120	175	65	90	45	90	10	50	75	150	300	400
February	120	175	70	90	40	80	10	50	75	150	300	400
March	120	175	75	95	35	70	10	50	75	150	300	400
April	125	200	75	100	30	65	10	50	90	175	300	400
May	140	275	90	125	30	65	15	35	125	300	300	750
June	135	250	75	110	30	60	15	40	125	300	300	700
July	125	200	65	100	30	60	15	65	120	175	300	400
August	120	175	50	90	30	60	15	90	100	175	300	400
September	120	175	60	100	30	60	15	110	100	175	300	400
October	125	200	65	100	40	75	15	100	125	200	300	450
November	130	235	70	100	40	90	10	35	125	200	300	450
December	130	225	70	100	45	75	12	60	125	200	300	400
1905.												
January	150	200	75	110	40	90	10	50	75	150	300	400
February	150	200	85	125	40	90	10	50	75	150	300	400
March	150	200	90	135	35	90	10	50	75	150	300	400
April	150	225	75	120	35	80	10	50	90	175	300	400
May	150	295	60	90	30	80	15	40	90	300	300	750
June	135	225	60	90	30	75	15	50	90	300	300	750
July	125	200	60	100	30	70	15	75	100	150	300	400
August	130	200	60	100	30	70	15	117	100	150	300	400
September	130	200	65	100	35	75	15	110	100	150	300	400
October	140	200	70	110	45	85	15	95	100	175	300	450
November	150	250	80	125	30	100	15	70	125	200	300	450
December	150	250	80	120	50	95	10	65	125	200	300	400
1906.												
January	140	225	85	135	40	90	10	50	100	175	300	400
February	140	225	85	135	35	90	10	50	100	175	300	450
March	140	250	85	135	35	80	10	50	100	175	300	450
April	140	275	80	130	30	75	10	50	100	175	300	500
May	140	335	75	110	30	85	15	6	100	350	300	750
June	135	275	75	150	30	75	15	115	100	300	300	750
July	125	225	75	150	40	90	15	120	100	150	300	400
August	130	225	75	150	40	90	15	120	100	200	300	400
September	130	225	75	150	40	90	15	122	100	225	300	500
October	140	250	75	150	40	90	15	80	100	200	300	450
November	150	250	85	150	35	90	15	75	125	200	300	450
December	150	250	85	150	35	90	10	65	125	200	300	400
1907.												
January	160	300	100	150	65	115	10	50	110	200	300	450
February	165	320	100	150	65	115	10	50	110	200	300	450
March	175	325	110	160	75	125	10	50	125	225	300	450
April	185	350	115	165	80	135	10	50	140	300	300	475
May	200	400	125	175	80	135	10	56	160	425	325	750
June	185	375	135	175	85	140	20	120	160	400	325	750
July	175	350	130	165	75	125	35	125	160	400	300	600
August	165	300	125	150	50	110	30	150	160	350	300	500
September	150	275	125	150	65	110	35	160	150	325	300	450
October	150	250	125	150	70	115	15	125	140	300	300	475
November	165	275	110	140	65	85	10	80	85	185	300	450
December	150	250	95	145	65	85	10	50	110	200	300	450

CATTLE.

Number and value of milch cows and other cattle, 1867–1908.

January 1—	Milch cows.			Other cattle.		
	Number.	Price per head Jan. 1.	Farm value Jan. 1.	Number.	Price per head Jan. 1.	Farm value Jan. 1.
1867	8,348,773	$28.74	$239,946,612	11,730,952	$15.79	$185,253,850
1868	8,691,568	26.56	230,816,717	11,942,484	15.06	179,887,797
1869	9,247,714	29.15	269,610,021	12,185,385	18.73	228,183,001
1870	10,095,600	32.70	330,175,234	15,388,500	18.87	290,400,588
1871	10,023,000	33.89	339,700,528	16,212,200	20.78	336,859,617
1872	10,303,500	29.45	303,438,398	16,389,800	18.12	296,931,664
1873	10,575,900	26.72	282,559,051	16,413,800	18.06	296,448,036
1874	10,705,300	25.63	274,325,680	16,218,100	17.55	284,705,983
1875	10,906,800	25.74	280,700,645	16,313,400	16.91	275,871,664
1876	11,085,400	25.61	283,878,869	16,785,300	17.00	285,387,123
1877	11,260,800	25.47	286,778,030	17,956,100	15.99	287,155,528
1878	11,300,100	25.74	290,897,809	19,223,300	16.72	321,345,691
1879	11,826,400	21.71	256,720,779	21,408,100	15.38	329,253,631
1880	12,027,000	23.27	279,899,420	21,231,000	16.10	341,761,154
1881	12,368,653	23.95	296,277,060	20,938,710	17.33	362,861,509
1882	12,611,632	25.89	326,489,310	23,280,238	19.89	463,069,501
1883	13,125,685	30.21	396,575,405	28,046,077	21.81	611,549,109
1884	13,501,206	31.37	423,486,649	29,046,101	23.52	683,229,054
1885	13,904,722	29.70	412,903,093	29,866,573	23.25	694,382,913
1886	14,235,388	27.40	389,985,523	31,275,242	21.17	661,956,274
1887	14,522,083	26.08	378,789,589	33,511,750	19.79	663,137,926
1888	14,856,414	24.65	366,252,173	34,378,363	17.79	611,750,520
1889	15,298,625	23.94	366,226,376	35,032,417	17.05	597,236,812
1890	15,952,883	22.14	353,152,133	36,849,024	15.21	560,625,137
1891	16,019,591	21.62	346,397,900	36,875,648	14.76	544,127,908
1892	16,416,351	21.40	351,378,132	37,651,239	15.16	570,749,155
1893	16,424,087	21.75	357,299,785	35,954,196	15.24	547,882,204
1894	16,487,400	21.77	358,998,661	36,608,168	14.66	536,789,747
1895	16,504,629	21.97	362,601,729	34,364,216	14.06	482,999,129
1896	16,137,586	22.55	363,955,545	32,085,409	15.86	508,928,416
1897	15,941,727	23.16	369,239,993	30,508,408	16.65	507,929,421
1898	15,840,886	27.45	434,813,826	29,264,197	20.92	612,296,634
1899	15,990,115	29.66	474,233,925	27,994,225	22.79	637,931,135
1900	16,292,360	31.60	514,812,106	27,610,054	24.97	689,486,260
1901	16,833,657	30.00	505,093,077	45,500,213	19.93	906,644,003
1902	16,696,802	29.23	488,130,324	44,727,797	18.76	839,126,073
1903	17,105,227	30.21	516,711,914	44,659,206	18.45	824,054,902
1904	17,419,817	29.21	508,841,489	43,629,498	16.32	712,178,134
1905	17,572,464	27.44	482,272,203	43,669,443	15.15	661,571,308
1906	19,793,866	29.44	582,788,592	47,067,656	15.85	746,171,709
1907	20,968,265	31.00	645,496,980	51,565,731	17.10	881,557,398
1908	21,194,000	30.67	650,057,000	50,073,000	16.89	845,938,000

Imports and exports of live cattle, with average prices, 1892–1907.

Year ending June 30—	Imports.			Exports.		
	Number.	Value.	Average import price.	Number.	Value.	Average export price.
1892	2,168	$47,466	$21.89	394,607	$35,099,095	$88.95
1893	3,293	45,682	13.87	287,094	26,032,428	90.68
1894	1,592	18,704	11.75	359,278	33,461,922	93.14
1895	149,781	765,853	5.11	331,722	30,603,796	92.26
1896	217,826	1,509,856	6.93	372,461	34,560,672	92.79
1897	328,977	2,589,857	7.87	392,190	36,357,451	92.70
1898	291,589	2,913,223	9.99	439,255	37,827,500	86.12
1899	199,752	2,320,362	11.62	389,490	30,516,833	78.35
1900	181,006	2,257,694	12.47	397,286	30,635,153	77.11
1901	146,022	1,931,433	13.23	459,218	37,566,980	81.81
1902	96,027	1,608,722	16.75	392,884	29,902,212	76.11
1903	66,175	1,161,548	17.55	402,178	29,848,936	74.22
1904	16,056	310,737	19.35	593,409	42,256,291	71.21
1905	27,855	458,572	16.46	567,806	40,598,048	71.50
1906	29,019	548,430	18.90	584,239	42,081,170	72.03
1907	32,404	565,122	17.44	423,051	34,577,392	81.73

Number, average price, and farm value of cattle in the United States January 1, 1908.

State or Territory.	Milch cows.			Other cattle.		
	Number.	Average price per head Jan. 1.	Farm value Jan. 1.	Number.	Average price per head Jan. 1.	Farm value Jan. 1.
Maine	183,000	$31.00	$5,673,000	151,000	$16.00	$2,416,000
New Hampshire	128,000	32.50	4,160,000	103,000	17.00	1,751,000
Vermont	291,000	30.00	8,730,000	221,000	14.00	3,094,000
Massachusetts	196,000	40.00	7,840,000	92,000	17.00	1,564,000
Rhode Island	26,000	42.50	1,105,000	10,000	19.00	190,000
Connecticut	138,000	37.50	5,175,000	83,000	19.00	1,577,000
New York	1,789,000	33.50	59,932,000	907,000	17.00	15,419,000
New Jersey	190,000	43.00	8,170,000	82,000	21.00	1,722,000
Pennsylvania	1,152,000	36.00	41,472,000	965,000	18.00	17,370,000
Delaware	37,000	36.50	1,350,000	22,000	20.00	440,000
Maryland	155,000	32.00	4,960,000	140,000	20.00	2,800,000
Virginia	288,000	28.00	8,064,000	561,000	19.00	10,659,000
West Virginia	247,000	33.00	8,151,000	549,000	22.00	12,078,000
North Carolina	294,000	24.00	7,056,000	450,000	12.00	5,400,000
South Carolina	138,000	27.00	3,726,000	223,000	12.00	2,676,000
Georgia	308,000	25.00	7,700,000	680,000	11.00	7,480,000
Florida	91,000	29.00	2,639,000	664,000	10.00	6,640,000
Ohio	928,000	36.00	33,408,000	1,050,000	21.00	22,050,000
Indiana	660,000	33.00	21,780,000	1,096,000	21.00	23,016,000
Illinois	1,184,000	35.00	41,440,000	2,164,000	22.00	47,608,000
Michigan	849,000	34.00	28,866,000	1,003,000	16.00	16,048,000
Wisconsin	1,392,000	30.50	42,456,000	1,137,000	13.00	14,781,000
Minnesota	1,040,000	28.00	29,120,000	1,279,000	12.00	15,348,000
Iowa	1,555,000	30.50	47,428,000	3,881,000	21.00	81,501,000
Missouri	965,000	28.50	27,502,000	2,349,000	20.00	46,980,000
North Dakota	224,000	27.50	6,160,000	642,000	16.00	10,272,000
South Dakota	618,000	27.50	16,995,000	1,426,000	18.00	25,668,000
Nebraska	879,000	29.00	25,491,000	3,265,000	19.00	62,035,000
Kansas	722,000	29.00	20,938,000	3,577,000	20.00	71,540,000
Kentucky	398,000	27.50	10,945,000	714,000	18.00	12,852,000
Tennessee	331,000	23.00	7,613,000	595,000	12.00	7,140,000
Alabama	283,000	21.00	5,943,000	539,000	8.00	4,312,000
Mississippi	330,000	20.00	6,600,000	589,000	8.00	4,712,000
Louisiana	190,000	24.00	4,560,000	480,000	10.00	4,800,000
Texas	1,072,000	26.00	27,872,000	7,825,000	12.00	93,900,000
Oklahoma	338,000	26.00	8,788,000	1,814,000	16.00	29,024,000
Arkansas	384,000	18.50	7,104,000	695,000	8.00	5,560,000
Montana	69,000	36.00	2,484,000	879,000	20.00	17,580,000
Wyoming	23,000	38.00	874,000	838,000	24.00	20,112,000
Colorado	144,000	37.00	5,328,000	1,454,000	20.00	29,080,000
New Mexico	25,000	38.00	950,000	939,000	17.00	15,963,000
Arizona	23,000	43.00	989,000	603,000	17.00	10,251,000
Utah	79,000	31.00	2,449,000	324,000	17.00	5,508,000
Nevada	17,000	45.00	765,000	367,000	20.00	7,340,000
Idaho	69,000	32.00	2,208,000	344,000	17.00	5,848,000
Washington	184,000	37.00	6,808,000	389,000	18.00	7,002,000
Oregon	158,000	35.00	5,530,000	758,000	17.00	12,886,000
California	410,000	36.00	14,760,000	1,155,000	19.00	21,945,000
United States	21,194,000	30.67	650,057,000	50,073,000	16.89	845,938,000

Wholesale prices of cattle per 100 pounds, 1903–1907.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to prime.		Fair to medium.		Good to choice native steers.		Native beeves.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
January	$2.00	$6.85	$3.15	$4.35	$5.10	$5.75	$3.35	$5.10
February	2.35	6.15	3.10	4.25	5.10	5.25	3.15	5.15
March	2.50	5.75	3.35	4.40	5.10	5.40	3.45	5.35
April	2.50	5.80	3.75	4.40	5.10	5.60	3.20	5.25
May	2.50	5.65	3.25	4.40	5.00	5.50	3.85	5.10
June	2.25	5.65	3.00	4.40	5.10	5.25	3.75	5.30
July	2.25	5.65	2.85	4.10	5.15	5.35	3.65	5.35
August	2.15	6.10	2.50	4.00	5.25	5.55	3.85	5.75
September	2.00	6.15	2.25	3.75	5.60	5.70	3.60	5.75
October	1.65	6.00	2.50	3.65	5.40	5.55	3.90	5.50
November	1.50	5.85	2.35	3.40	5.15	5.40	3.00	5.30
December	1.50	8.35	2.35	3.75	5.10	6.00	2.65	5.30
1904.								
January	2.10	5.90	3.00	4.00	5.15	5.35	3.20	5.10
February	2.25	6.00	3.00	3.75	4.90	5.35	3.00	5.50
March	2.15	6.00	3.00	4.00	5.00	5.35	2.75	5.20
April	2.25	5.80	3.15	4.00	5.25	5.40	3.00	5.10
May	2.35	5.85	3.10	4.25	5.05	5.35	3.00	5.55
June	2.35	6.70	3.00	4.25	5.75	6.40	3.50	6.25
July	2.20	6.65	3.00	4.25	5.90	6.25	3.40	6.00
August	2.20	6.40	2.65	4.00	5.60	6.00	3.25	5.85
September	2.15	6.40	2.50	3.75	5.75	6.00	4.00	6.00
October	1.70	7.00	2.50	3.75	6.05	6.60	4.25	6.35
November	1.70	7.15	2.50	3.50	5.15	6.60	3.10	6.15
December	1.80	7.65	2.25	3.60	5.75	6.00	3.10	6.15
1905.								
January	1.85	6.30	2.65	3.85	5.15	5.50	3.05	5.35
February	1.90	6.45	2.65	4.00	5.15	6.00	3.15	5.25
March	2.20	6.25	2.50	4.40	5.50	5.65	3.20	5.65
April	2.40	7.00	3.50	4.75	5.90	6.75	3.25	6.50
May	2.35	6.85	3.15	4.65	5.85	6.50	3.75	6.80
June	2.30	6.35	3.00	4.25	5.25	6.50	3.70	5.95
July	2.00	6.25	3.00	4.40	5.25	5.85	3.50	5.40
August	2.10	6.30	2.85	4.10	5.50	5.70	3.25	6.15
September	2.00	6.50	2.75	4.00	5.50	6.35	3.40	5.90
October	2.10	6.40	2.50	3.85	6.00	6.15	3.10	5.75
November	2.15	6.60	2.35	3.75	5.40	6.15	3.50	6.50
December	2.15	7.00	2.65	4.00	5.50	7.10	3.05	5.60
1906.								
January	2.00	6.50	2.85	4.00	5.45	6.00	3.10	5.50
February	2.10	6.40	3.25	4.35	5.65	6.00	3.00	5.60
March	2.25	6.35	3.25	4.50	5.75	6.00	3.10	5.60
April	2.35	6.35	3.00	4.40	5.50	5.75	3.35	5.50
May	2.50	6.20	3.00	4.35	5.45	5.80	3.50	5.65
June	1.75	6.10	2.75	4.00	5.50	6.00	3.35	5.70
July	2.00	6.50	2.60	4.40	5.85	6.10	3.10	6.25
August	2.00	6.85	2.50	4.25	5.85	6.30	3.05	6.25
September	2.05	6.95	2.50	4.40	6.25	6.40	2.90	6.40
October	2.00	6.95	2.40	4.35	6.15	6.75	3.75	6.35
November	1.75	7.40	2.35	4.50	5.85	7.00	3.25	6.40
December	1.75	7.90	2.75	4.50	6.00	7.00	3.00	6.85
1907.								
January	2.00	7.30	4.60	5.40	6.10	6.55	3.10	6.10
February	2.00	7.25	4.40	5.25	5.75	6.10	3.20	5.85
March	2.00	6.90	4.65	5.50	6.00	6.25	3.25	5.80
April	2.50	6.75	4.75	5.70	5.85	6.25	3.80	5.85
May	2.20	6.50	4.65	5.60	5.90	6.05	3.75	6.10
June	2.25	7.10	4.75	5.75	6.00	6.85	4.25	6.75
July	2.00	7.50	5.00	5.90	6.90	7.25	3.25	7.10
August	2.00	7.60	4.90	6.00	6.65	7.35	3.35	7.30
September	2.00	7.35	5.00	5.65	6.65	7.00	5.25	7.10
October	2.00	7.45	4.85	5.50	6.70	7.00	4.25	7.05
November	2.00	7.25	4.10	5.00	5.35	6.60	3.50	6.40
December	2.00	8.00	4.15	5.15	5.40	6.75	3.15	5.70

BUTTER.

Wholesale prices of butter per pound, 1903–1907.

Date.	New York. Creamery extra. Low.	New York. Creamery extra. High.	Cincinnati. Creamery. Low.	Cincinnati. Creamery. High.	Chicago. Creamery firsts. Low.	Chicago. Creamery firsts. High.	Elgin. Creamery extra. Low.	Elgin. Creamery extra. High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1903.								
January	28½	28½	22	27	20	28	25	29
February	26	28	22	25	20	27½	25	27
March	27	29½	24½	26	24	28½	27½	28½
April	22½	29½	19½	26	21	28½	22½	28½
May	22	23	17½	20½	17	22	20	22½
June	20½	22½	18	21	18	22	20	22
July	19	20½	15½	20	17	20	18½	20
August	19	19½	15½	18½	16	19	18½	19½
September	19¾	21¾	16½	20	17	21½	19½	21½
October	20	22¾	18	20	17	21½	20½	21½
November	22½	25½	19½	22½	18	24½	22	24
December	23	25½	21½	23½	19	25	24	25
1904.								
January	22	24½	19½	22½	17	23½	22	24
February	23	26½	21½	24	18	26	23	26
March	24	26½	22	24	19	26	24½	26
April	22	24½	20½	23	19	24½	23	24½
May	18	24½	17½	21½	15	23	17½	23
June	17¾	18¾	17½	19	15	18	17½	17½
July	17½	18	17	19	15	18	17	17½
August	17½	19¼	17	19	15	18½	17	19
September	19	21	19	20½	16½	19½	19	20
October	20	23¼	20	22	17	22	20	23
November	23	26½	23	25½	19	24½	23	25
December	26	28	26½	28	20	28	25	28
1905.								
January	28	30½	28	30½	22	30	28	29½
February	29½	35½	30	34	25	34	29	34
March	25	31½	24	30	22	32	25	33
April	27	32	26	32	22	31	27	31½
May	20¾	27	20½	25	18	24	21	25
June	19½	21½	19	21	18	20½	19½	20½
July	20½	21¼	19½	20½	18	20½	20	20
August	20½	22	20	21½	18½	21	20	21
September	20½	21¾	20	21½	18	21	20½	21
October	20	22	20½	23	19	22	21	22½
November	17½	24½	22	24½	20	23	22½	24
December	24	26	23½	25	19	24½	24	25
1906.								
January	25	27½	25½	27	20	27	26	27
February	26	27½	26½	29½	22	27½	27	28½
March	27	27½	27	28	21	27½	27	28½
April	21	25½	21	27	17	26½	21	26
May	19½	22	19	22	16½	20	19	21
June	19½	21	19½	21	16½	21	19½	20
July	20½	21½	20	22½	18	20	20	21½
August	21	24½	21½	24	18	23	21½	23
September	24	25½	24	25½	20½	24	24	24½
October	25½	27	24½	27	22	25½	24½	26
November	27	30½	26	31	22	28½	26	30
December	30½	33	30	32½	25	31	30	31½
1907.								
January	28	33	29	33	22	31	29	32
February	32½	34	32	34	23	32½	32	33
March	29½	34	30	32	25	32½	30	32
April	27	35	27	31	25	32½	27	33
May	24½	27½	23	26	18	25	23	25
June	23½	25	23	24½	18	24	23	23
July	24½	27	26	27	18	25	24	25
August	24½	26½	26	27½	20	25	24	26
September	26	29½	28	30½	21	28½	26	28½
October	26	30	29	32	22½	29½	27	30
November	24½	28	26	29	20	27	24	27
December	28	29½	29	31	21	29	27	29

International trade in butter, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	Jan. 1	9,094,269	11,750,944	11,672,157	11,890,040	9,712,076
Australia	Jan. 1	7,777,971	30,901,910	64,788,542	55,904,151	75,765,536
Austria-Hungary	Jan. 1	15,589,764	13,728,181	11,233,431	8,944,151	7,740,648
Belgium	Jan. 1	5,643,178	4,492,080	4,340,012	3,800,594	3,704,232
Canada	July 1	34,128,944	24,568,001	31,764,303	34,031,525	[b] 18,243,740
Denmark	Jan. 1	153,808,614	176,664,571	179,745,595	176,081,731	175,043,639
Finland	Jan. 1	21,315,888	22,700,563	26,891,790	35,135,901	33,192,114
France	Jan. 1	53,879,727	59,714,579	49,842,670	49,781,584	39,307,325
Germany [c]	Jan. 1	4,849,727	2,796,343	1,766,564	1,834,907	951,515
Italy	Jan. 1	13,420,636	14,176,381	12,375,425	13,359,789	10,746,430
Netherlands	Jan. 1	50,413,634	51,659,135	52,053,041	51,162,980	56,404,861
New Zealand	Jan. 1	28,447,776	31,931,872	35,208,320	34,240,864	35,865,200
Norway	Jan. 1	3,015,570	2,717,219	3,367,075	3,612,714	3,281,403
Russia	Jan. 1	83,463,073	90,863,488	87,705,713	86,966,484	[b] 114,369,238
Sweden	Jan. 1	44,213,494	44,248,776	43,144,662	40,636,298	35,712,817
United States	July 1	8,896,166	10,717,824	10,071,487	27,360,537	12,544,777
Other countries		2,911,000	2,982,000	2,457,000	3,952,034	[b] 3,726,146
Total		540,869,431	596,613,867	628,427,787	638,696,284	636,311,697

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Australia	Jan. 1	6,901,779	1,887,148	43,873	592,201	70,143
Belgium	Jan. 1	7,375,362	9,788,817	9,727,714	10,054,979	11,128,520
Brazil	Jan. 1	6,270,893	5,496,134	5,642,179	6,567,718	5,344,412
Cape of Good Hope	Jan. 1	6,341,566	6,055,075	5,294,516	5,251,721	4,681,766
Denmark	Jan. 1	15,432,354	12,786,808	13,007,270	12,566,345	13,049,158
Dutch East Indies	Jan. 1	2,788,108	2,945,909	3,021,377	2,957,073	3,049,962
Egypt	Jan. 1	2,199,657	2,366,386	3,126,945	3,066,949	2,958,784
France	Jan. 1	12,042,518	10,260,344	10,067,424	10,066,650	11,402,808
Germany [c]	Jan. 1	36,794,039	53,558,205	75,705,838	79,524,904	80,896,179
Natal	Jan. 1	1,662,002	2,121,121	3,171,875	2,142,003	[d] 2,142,003
Netherlands	Jan. 1	1,514,533	2,665,917	5,358,391	5,439,836	5,630,865
Russia	Jan. 1	856,054	838,214	1,158,390	1,103,318	[b] 577,805
Sweden	Jan. 1	1,148,959	919,839	1,305,925	911,993	1,316,117
Switzerland	Jan. 1	9,705,187	10,970,199	10,889,289	11,955,445	7,822,660
Transvaal	Jan. 1	3,269,411	5,119,642	4,514,468	4,731,433	[d] 4,731,433
United Kingdom	Jan. 1	440,221,264	447,684,496	465,285,968	456,662,976	477,092,448
Other		13,984,000	14,563,000	12,295,000	17,009,360	[b] 18,968,003
Total		568,507,686	590,027,254	630,116,442	630,604,904	650,863,066

[a] See "General note," p. 615.
[b] Preliminary.
[c] Not including free ports prior to March 1, 1906.
[d] Year preceding.

CHEESE.

Wholesale prices of cheese per pound, 1903–1907.

Date.	New York.		Cincinnati.		Chicago.		St. Louis.	
	September, colored.		Factory.		Young Americas.		Full cream.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	14	14	12½	12¾	13	13½	14	14¼
February	14½	14½	12½	12½	12½	13	14¼	14¼
March	14½	15	12½	12½	12½	13¼	14¼	14¼
April	15	15	12½	12½	12½	13¼	13¼	14¼
May	11½	12¼	12½	12½	10½	13¾	12¾	14¾
June	10½	10¾	11	11¼	10½	10½	11½	11¾
July	10	10½	10½	10¾	10	10¾	11¾	12
August	10¼	10½	10½	10½	9	11	11¾	12
September	10⅜	12¼	10½	10½	9½	11	11¾	12¼
October	11½	12¼	10½	10½	10	11	11¾	12¼
November	11½	12	10½	10½	10	10½	11½	11½
December	12	12	10½	10½	10	10	11½	11½
1904.								
January	12	12	10½	10½	10	10	11½	11½
February	12	12	10½	10½	9½	10½	11½	11¾
March	12	12	10½	10½	10	10¾	12	12
April	10¾	12	10½	10½	9	10	9	11½
May	7	8	9½	10	8	9	10¼	10¼
June	7¾	9	8	9½	7¼	8½	9¼	10¼
July	8	9	8	8½	7¼	8¾	9¼	9¾
August	8	9	8	9	7¾	8¾	9½	10
September	8¾	10	8½	9	8	8½	10	10¾
October	10	10½	8½	9	8¼	10½	11	11½
November	10¼	11¾	8½	10½	10	11½	11¾	13¼
December	11¾	12	10	10½	11	11½	13½	13½
1905.								
January	11½	11¾	12½	13	11¾	12	13½	13¾
February	11¾	13¼	12½	13	11¾	13½	13¾	14½
March	13¾	14½	12½	14¼	....	13½	14½	15
April	13¾	14¼	14	14¼	13½	14	14	15½
May	14¼	14¼	14	14¼	10	14	11½	15½
June	9	9¾	10	12¼	10	10½	11¼	11½
July	9½	11⅛	10	10¼	10¼	11½	11¾	12¼
August	10¼	12	11	11¼	11	11¾	12	12½
September	11¾	12	11	12½	11½	11¾	12½	12¾
October	11½	13¼	12	12½	11½	12¼	12½	13½
November	13¼	13¾	13½	14	13	13¾	14	14
December	12	14	13½	14	13	13½	13¼	13½
1906.								
January	14	14½	12½	13½	....	13	13¼	13¼
February	14	14¼	13½	....	....	13	13¼	13¼
March	14	14¼	13½	....	11½	13	13	13¼
April	14¼	14¼	13½	....	11	12	12¼	13
May	9½	14¼	11	13½	9½	11¾	11¼	12¼
June	9½	11	11	....	10½	11½	11⅝	12½
July	11	11½	11	....	11¼	11¾	12½	12¾
August	11½	12¾	12	13	12	12¾	12¾	14
September	12½	13	13	....	12¼	12½	13½	14
October	13¼	13½	13	13¾	12½	13¼	14	14½
November	13¼	14	13½	13¾	13	13¾	14¼	15¼
December	14	14½	13½	14	13½	14	15¼	15¼
1907.								
January	14½	14½	14½	15	14	14¼	15¼	15¾
February	14½	14¾	14½	15	14¼	16	15	16½
March	14¾	15	15	15½	15	16	15	16½
April	15	15	15	15½	14½	15½	12¼	13
May	12	15	14	15½	14	15	15	15¾
June	11¾	12½	13½	14	13	14	14	14½
July	12¼	12¾	13½	14	13	13½	14¼	15
August	12	13½	14	....	....	13½	14½	14¾
September	13¾	14¾	14	....	13½	14¼	14¾	15¼
October	11¾	16¼	14	15½	14	15½	14¾	16½
November	15¼	15¾	15½	....	12½	15½	13¾	14¾
December	15¼	15¾	15½	....	11½	13	13	14

International trade in cheese, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Bulgaria	Jan. 1	5,651,335	7,064,385	6,624,517	7,227,827	6,606,741
Canada	July 1	229,099,925	233,980,716	215,733,259	215,834,543	[b] 200,824,470
France	Jan. 1	20,545,803	23,119,970	20,711,480	22,125,152	22,058,487
Germany [c]	Jan. 1	3,119,981	2,813,539	2,597,927	2,650,397	2,629,673
Italy	Jan. 1	28,841,967	33,158,617	30,299,443	37,696,611	42,314,633
Netherlands	Jan. 1	104,785,152	109,025,968	103,069,081	98,438,575	104,742,665
New Zealand	Jan. 1	8,371,552	8,375,360	9,466,912	9,918,944	14,695,072
Russia	Jan. 1	1,655,230	1,406,557	1,396,951	1,382,181	[b] 1,733,414
Switzerland	Jan. 1	54,491,422	53,642,863	56,688,989	61,383,731	61,935,107
United States	July 1	18,987,178	23,335,172	10,134,424	16,562,451	17,285,230
Other countries		9,469,000	8,833,000	7,050,000	7,509,354	[b] 9,111,773
Total		485,018,545	504,756,147	463,772,983	480,729,766	483,937,265

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Argentina	Jan. 1	3,614,879	2,489,821	4,069,223	4,234,616	7,304,669
Australia	Jan. 1	2,318,110	1,141,300	375,642	384,718	304,951
Austria-Hungary	Jan. 1	7,263,348	7,527,020	8,213,540	9,358,179	8,935,994
Belgium	Jan. 1	25,776,099	27,994,030	26,304,868	28,488,857	30,333,690
Brazil	Jan. 1	3,062,639	2,903,536	3,043,516	3,120,168	3,784,774
Cape of Good Hope	Jan. 1	3,689,735	4,251,460	3,994,730	3,249,035	3,228,593
Cuba	Jan. 1	3,119,835	2,900,902	3,333,992	4,202,427	4,078,517
Denmark	Jan. 1	2,085,131	2,052,503	2,033,764	1,932,351	1,782,437
Egypt	Jan. 1	6,947,708	6,947,710	8,495,738	9,512,371	10,064,909
France	Jan. 1	42,362,780	48,434,148	40,683,327	43,254,168	44,714,972
Germany [c]	Jan. 1	35,067,820	35,859,059	39,750,657	44,698,270	48,187,525
Italy	Jan. 1	8,859,053	9,474,363	9,568,500	9,921,901	10,398,761
Russia	Jan. 1	2,829,871	3,191,252	3,302,985	2,914,736	[b] 2,852,911
Spain	Jan. 1	4,280,926	4,033,420	4,338,306	3,901,938	4,255,835
Switzerland	Jan. 1	5,710,853	5,879,065	6,567,789	5,530,515	5,541,979
United Kingdom	Jan. 1	279,367,088	296,012,528	280,125,104	267,722,560	289,371,824
United States	July 1	20,671,384	22,707,103	23,095,705	27,286,866	33,848,766
Other countries		14,598,000	14,549,000	18,785,000	19,072,721	[b] 20,626,214
Total		471,625,259	498,348,220	486,082,386	488,786,397	529,617,321

[a] See "General note," p. 615. [b] Preliminary. [c] Not including free ports prior to March 1, 1906.

EGGS.

Wholesale prices of eggs per dozen, 1903–1907.

Date.	New York. Average best fresh.		Cincinnati.		Chicago. Fresh.		St. Louis. Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	24	28	20	26	21	26½	17½	22½
February	16	25	12	20	14	20	12½	18
March	14½	21	12	16½	12½	20	11	16½
April	15	17½	12	14	12½	15½	11	14¼
May	16	19	13½	14	13	15	12¼	14
June	17½	19½	13½	14	12½	15½	12½	15
July	18½	23	12	14	11	16	11	12½
August	15½	26	12½	18	10	19	14	19
September	19	28	18	19	16	20	18½	19
October	21	33	19	22	17	23	19	21½
November	22	45	20	28	18	28	21½	26
December	28	45	20	26	22	30	24	28½
1904.								
January	27	47	23	32	22	34½	28	29
February	20	40	19	29	18	33½	17¾	29
March	16	25	14½	20	14¾	20	13¼	16
April	17	21	15½	17	15½	18½	14½	15½
May	17	21	15	17	14	18	13	15½
June	17½	21	15½	16	13	17½	14½	15½
July	17½	24	15½	16	11	20	13	17½
August	19	26	15	18	11	20½	16	19½
September	20	30	16	19	13	22	17½	20½
October	20	30	18	20	13	23½	19	20½
November	21	38	21	26	17	28	21½	27
December	20	40	22	27	16	30	24	27
1905.								
January	22	40	22	27	18	31	22	29
February	24	40	24	30	20	36	28	34
March	17	40	14½	23	14½	31	14	22½
April	17½	21	15	16	14½	19	14½	15½
May	17½	21	15	16	14	18½	12½	16½
June	16½	22	14½	15	12	17½	14	15½
July	16½	25	14	14½	12	20½	10½	14
August	18	28	14	17	12½	22	14	16½
September	20	30	17	19	13	22½	16½	16½
October	21	35	18½	23	15	25	16½	19
November	25	40	23	28	16	30	19	24
December	26	40	24	27	18	31	22½	24
1906.								
January	17½	34	16	24	16	27	14	22
February	15½	27	13	17	11	21½	11½	17
March	14½	22	13	13½	12	17	12	15
April	17	22	14	16½	14	19½	13½	16
May	16	21	14	14½	12	18½	13	14
June	17	23	14	14½	12	19	15	17
July	17	25	14	15½	12	18½	12½	13
August	18	28	14½	18	12	20½	13	15
September	21	33	19	21	12	24½	15	17½
October	20	3[illegible]	22	24	15	27	18	22
November	20	42	28	29	20	32	20	26
December	22	45	25	29	20	36	21	26
1907.								
January	25	36	22	25	23	28	21	22½
February	25	32	20	24	24	30	16½	25½
March	17	30	15	16	16	22	14	17
April	16½	21	14½	15	15	17½	13½	16
May	16½	21	13½	15	14½	17	13	14
June	16	20	13½	....	13	15	12	13
July	16	26	14½	15	13	16	12	13
August	18	30	15	20	16	20	12	16
September	20	32	20	21	18½	21½	16	17½
October	23	45	21	23	21	24	17½	18½
November	26	50	25	28	22	26	19	21
December	25	50	26	29	22	27	20	23

SHEEP AND WOOL.

Number and farm value of sheep, 1867–1908.

Year.	Sheep. Number.	Price per head Jan. 1.	Farm value Jan. 1.	Year.	Sheep. Number.	Price per head Jan. 1.	Farm value Jan. 1.
1867	39,385,386	$2.50	$98,643,878	1888	43,544,755	$2.05	$89,279,926
1868	38,991,912	1.82	71,052,570	1889	42,599,079	2.13	90,640,369
1869	37,724,279	1.64	62,036,752	1890	44,336,072	2.27	100,659,761
1870	40,853,000	1.96	79,875,996	1891	43,431,136	2.50	108,397,447
1871	31,851,000	2.14	68,310,110	1892	44,938,365	2.58	116,121,290
1872	31,679,300	2.61	82,767,741	1893	47,273,553	2.66	125,909,264
1873	33,002,400	2.71	89,426,606	1894	45,048,017	1.98	89,186,110
1874	33,938,200	2.43	82,352,976	1895	42,294,064	1.58	66,685,767
1875	33,783,600	2.55	86,278,163	1896	38,298,783	1.70	65,167,735
1876	35,935,300	2.37	85,120,646	1897	36,818,643	1.82	67,020,942
1877	35,804,200	2.13	76,361,698	1898	37,656,960	2.46	92,721,133
1878	35,740,500	2.21	78,897,594	1899	39,114,453	2.75	107,697,530
1879	38,123,800	2.07	78,964,563	1900	41,883,065	2.93	122,665,913
1880	40,765,900	2.21	90,230,537	1901	59,756,718	2.98	178,072,476
1881	43,569,899	2.39	104,070,861	1902	62,039,091	2.65	164,446,091
1882	45,016,224	2.37	106,595,954	1903	63,964,876	2.63	168,315,750
1883	49,237,291	2.53	124,365,835	1904	51,630,144	2.59	133,530,099
1884	50,626,626	2.37	119,902,706	1905	45,170,423	2.82	127,331,850
1885	50,360,243	2.14	107,960,650	1906	50,631,619	3.54	179,056,144
1886	48,322,331	1.91	92,443,867	1907	53,240,282	3.84	204,210,129
1887	44,759,314	2.01	89,872,839	1908	54,631,000	3.88	211,736,000

Number, average price, and farm value of sheep in the United States January 1, 1908.

State or Territory.	Number.	Average price per head Jan. 1.	Farm value Jan. 1.	State or Territory.	Number.	Average price per head Jan. 1.	Farm value Jan. 1.
Maine	267,000	$4.09	$1,092,000	North Dakota	627,000	$3.56	$2,232,000
New Hampshire	77,000	3.87	298,000	South Dakota	821,000	3.63	2,980,000
Vermont	223,000	4.16	928,000	Nebraska	431,000	3.76	1,621,000
Massachusetts	45,000	4.49	202,000	Kansas	236,000	4.15	979,000
Rhode Island	8,000	4.40	35,000	Kentucky	1,071,000	4.22	4,520,000
Connecticut	34,000	4.75	162,000	Tennessee	348,000	3.39	1,180,000
New York	1,131,000	4.81	5,440,000	Alabama	188,000	1.94	365,000
New Jersey	44,000	4.99	220,000	Mississippi	181,000	1.80	326,000
Pennsylvania	1,102,000	4.62	5,091,000	Louisiana	180,000	1.79	322,000
Delaware	12,000	4.64	56,000	Texas	1,799,000	2.74	4,929,000
Maryland	163,000	4.55	742,000	Oklahoma	98,000	2.88	282,000
Virginia	512,000	4.00	2,048,000	Arkansas	266,000	2.13	567,000
West Virginia	675,000	4.40	2,970,000	Montana	5,524,000	3.90	21,544,000
North Carolina	220,000	2.62	576,000	Wyoming	5,885,000	4.15	24,423,000
South Carolina	59,000	2.17	128,000	Colorado	1,695,000	3.33	5,644,000
Georgia	269,000	2.01	541,000	New Mexico	4,787,000	3.45	16,515,000
Florida	101,000	1.97	199,000	Arizona	1,031,000	3.62	3,732,000
Ohio	3,110,000	4.48	13,933,000	Utah	2,967,000	3.88	11,512,000
Indiana	1,215,000	5.06	6,148,000	Nevada	1,586,000	3.79	6,011,000
Illinois	793,000	5.01	3,973,000	Idaho	3,575,000	3.55	12,691,000
Michigan	2,130,000	4.46	9,500,000	Washington	824,000	3.73	3,074,000
Wisconsin	1,044,000	4.15	4,333,000	Oregon	2,661,000	3.58	9,526,000
Minnesota	459,000	3.79	1,740,000	California	2,422,000	3.47	8,404,000
Iowa	718,000	4.97	3,568,000				
Missouri	1,017,000	4.36	4,434,000	United States	54,631,000	3.88	211,736,000

Imports and exports of sheep, with average prices, 1892–1907.

Year ending June 30—	Imports.			Exports.		
	Number.	Value.	Average import price.	Number.	Value.	Average export price.
1892	380,814	$1,440,530	$3.78	46,960	$161,105	$3.43
1893	459,484	1,682,977	3.66	37,260	126,394	3.39
1894	242,568	788,181	3.25	132,370	832,763	6.29
1895	291,461	682,618	2.34	405,748	2,630,686	6.48
1896	322,692	853,530	2.65	491,565	3,076,384	6.26
1897	405,633	1,019,668	2.51	244,120	1,531,645	6.27
1898	392,314	1,106,322	2.82	199,690	1,213,886	6.08
1899	345,911	1,200,081	3.47	143,286	853,555	5.96
1900	381,792	1,365,026	3.58	125,772	733,477	5.83
1901	331,488	1,236,277	3.73	297,925	1,933,000	6.49
1902	266,953	956,711	3.58	358,720	1,940,060	5.41
1903	301,623	1,036,934	3.44	176,961	1,067,860	6.03
1904	238,094	815,289	3.42	301,313	1,954,604	6.49
1905	186,942	704,721	3.77	268,365	1,687,321	6.29
1906	240,747	1,020,359	4.24	142,690	804,090	5.64
1907	224,798	1,120,425	4.98	135,344	750,242	5.54

Prices of sheep per 100 pounds, 1903–1907.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to choice.		Good to extra.		Good to choice natives.		Native.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
January	$1.50	$5.25	$3.25	$4.50	$4.50	$5.00	$3.60	$5.40
February	2.00	5.75	3.75	5.00	5.25	5.25	4.50	5.80
March	2.00	7.00	4.25	6.00	5.50	6.15	4.60	6.75
April	2.25	7.00	4.10	6.25	6.00	6.25	4.50	6.75
May	1.60	6.25	3.60	4.75	4.50	5.25	4.00	5.50
June	2.00	6.00	3.00	4.50	4.50	4.75	3.80	5.50
July	1.50	5.25	2.90	4.00	3.75	4.75	3.00	4.50
August	1.50	4.25	2.75	3.35	3.50	3.85	3.00	4.00
September	1.50	4.25	2.60	3.40	3.65	4.00	3.50	3.50
October	1.50	4.25	2.75	3.50	3.65	4.00	3.55	3.55
November	1.25	4.35	2.60	3.35	3.60	3.65	3.25	4.00
December	1.50	4.25	2.60	3.75	3.65	3.85	3.25	4.40
1904.								
January	2.00	4.75	3.25	4.00	3.75	4.75	2.25	5.10
February	2.00	4.75	3.40	4.60	4.75	4.75	2.60	5.25
March	2.00	5.50	3.65	4.50	4.75	4.90	2.50	5.25
April	2.50	6.00	4.00	4.50	5.40	5.60	3.25	5.65
May	2.00	6.00	3.75	4.55	5.50	5.65	4.00	5.90
June	1.75	5.50	3.00	4.40	4.60	5.50	4.00	5.25
July	1.50	5.50	2.75	4.00	4.00	4.25	3.75	5.00
August	2.00	4.25	2.75	4.00	3.75	4.00	3.40	4.35
September	1.75	4.50	2.75	3.50	3.75	4.00	....	....
October	1.50	4.75	2.75	3.50	4.10	4.50	....	....
November	1.75	5.00	2.75	4.00	4.25	4.75	3.75	4.50
December	2.50	5.65	3.50	4.50	4.75	4.90	4.00	5.50
1905.								
January	4.50	5.85	4.10	5.25	5.15	6.35	3.25	6.25
February	4.50	6.25	4.50	5.50	5.50	6.15	3.00	6.90
March	4.75	6.25	4.75	5.50	5.85	6.25	3.00	6.75
April	4.50	6.30	4.50	5.25	5.25	5.90	2.75	6.75
May	4.00	5.50	3.85	5.00	5.00	5.40	2.50	6.00
June	4.00	5.25	3.60	4.35	4.80	5.00	2.50	5.70
July	4.00	5.90	3.60	4.75	5.00	5.50	4.75	6.00
August	4.00	5.65	3.75	4.50	4.60	5.20	4.00	5.30
September	3.80	5.40	4.00	4.75	5.00	5.00	3.75	5.25
October	4.00	5.70	4.00	5.25	5.25	5.60	4.00	6.00
November	4.25	6.10	4.10	5.00	5.25	5.75	4.25	6.00
December	4.25	6.25	4.10	5.15	5.50	6.00	4.50	6.25
1906.								
January	3.75	6.25	4.50	5.50	5.75	6.25	4.00	4.60
February	3.50	6.25	4.35	5.50	5.50	6.25	3.50	6.25
March	3.50	6.50	5.00	5.75	5.50	6.45	2.75	6.00
April	3.50	6.50	4.00	5.75	5.50	6.00	3.25	6.15
May	3.75	6.50	4.10	4.75	6.00	6.25	4.50	6.40
June	3.50	6.25	4.40	5.25	6.00	6.10	3.80	6.50
July	3.00	6.25	4.10	4.75	5.25	5.75	4.00	6.25
August	3.00	5.60	4.10	4.75	5.00	5.50	4.50	5.85
September	3.50	5.75	4.10	4.75	5.35	5.75	4.25	5.85
October	3.50	5.75	3.85	4.75	5.35	5.50	4.75	5.65
November	3.25	5.75	4.00	4.60	5.50	5.60	4.50	6.10
December	3.00	7.00	4.00	4.75	5.50	6.00	4.75	6.35

Prices of sheep per 100 pounds, 1903–1907—Continued.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to choice.		Good to extra.		Good to choice natives.		Native.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1907.								
January	$2.25	$6.00	$4.25	$4.65	$5.50	$6.00	$3.50	$6.30
February	2.75	6.00	4.50	5.10	5.60	5.85	3.75	6.45
March	3.00	6.50	4.75	5.25	5.65	5.85	3.00	6.50
April	3.50	7.25	5.50	5.90	6.00	6.75	4.00	7.75
May	3.50	7.00	4.75	5.15	6.10	6.50	4.40	6.75
June	3.00	7.00	4.50	4.90	5.85	7.00	4.50	6.75
July	3.25	6.15	4.10	4.65	5.60	5.85	4.00	6.25
August	3.00	6.00	4.55	5.15	5.50	5.75	3.50	6.50
September	3.00	6.00	4.35	4.90	5.50	6.10	3.75	4.65
October	2.00	5.75	4.35	4.90	5.35	5.65	4.00	5.50
November	2.00	5.25	3.85	4.60	5.25	5.35	3.75	5.20
December	2.00	5.25	3.65	4.40	4.25	4.75	3.00	5.00

Wool product of the United States in 1907, by States.

[Estimate of National Association of Wool Manufacturers.]

State or Territory.	Number of sheep Apr. 1, 1907.	Average weight of fleece, 1907.	Per cent of shrinkage, 1907.	Wool, washed and unwashed	Wool, scoured.
		Pounds.	*Per cent.*	*Pounds.*	*Pounds.*
Maine	225,000	6	40	1,350,000	810,000
New Hampshire	70,000	6.2	50	434,000	217,000
Vermont	175,000	6	50	1,050,000	525,000
Massachusetts	30,000	5.8	42	174,000	100,920
Rhode Island	7,000	5	42	35,000	20,300
Connecticut	30,000	5	42	150,000	87,000
New York	800,000	6	50	4,800,000	2,400,000
New Jersey	40,000	5.5	50	220,000	110,000
Pennsylvania	900,000	6	50	5,400,000	2,700,000
Delaware	7,000	6	45	42,000	23,100
Maryland	100,000	5.5	45	550,000	302,500
Virginia	350,000	4.75	38	1,662,500	1,030,750
West Virginia	500,000	5.5	48	2,750,000	1,430,000
North Carolina	205,000	4.25	42	871,250	505,325
South Carolina	50,000	4	42	200,000	116,000
Georgia	250,000	3.8	40	950,000	570,000
Florida	100,000	3	40	300,000	180,000
Ohio	1,950,000	6.25	50	12,187,500	6,093,750
Indiana	800,000	6.5	45	5,200,000	2,860,000
Illinois	750,000	6.5	49	4,875,000	2,486,250
Michigan	1,500,000	6.3	51	9,450,000	4,630,500
Wisconsin	840,000	6.75	48	5,670,000	2,948,400
Minnesota	366,000	7	52	2,562,000	1,229,760
Iowa	500,000	6.5	50	3,250,000	1,625,000
Missouri	780,000	6.5	48	5,070,000	2,636,400
North Dakota	325,000	6.5	60	2,112,500	845,000
South Dakota	600,000	6.5	63	3,900,000	1,443,000
Nebraska	225,000	7	65	1,575,000	551,250
Kansas	160,000	7	65	1,120,000	392,000
Kentucky	590,000	4.75	39	2,802,500	1,709,525
Tennessee	270,000	4.25	40	1,147,500	668,500
Alabama	175,000	3.25	40	568,750	341,250
Mississippi	165,000	4	42	660,000	382,800
Louisiana	160,000	3.7	42	592,000	343,360
Texas	1,300,000	6.5	66	8,450,000	2,873,000
Oklahoma	60,000	6	67	360,000	118,800
Arkansas	225,000	4.25	41	956,250	564,188
Montana	4,600,000	6.7	63	30,820,000	11,403,400
Wyoming	4,484,931	7.5	68	33,637,000	10,763,840
Colorado	1,500,000	6.75	67	10,125,000	3,341,250
New Mexico	2,600,000	5.5	62	14,300,000	5,434,000
Arizona	650,000	6.5	65	4,225,000	1,478,750
Utah	2,075,000	6.7	65	13,902,500	4,865,875
Nevada	750,000	8	69	6,000,000	1,860,000
Idaho	2,500,000	7	67	17,250,000	5,692,500
Washington	575,000	8	68	4,600,000	1,472,000
Oregon	1,800,000	8.5	70	15,300,000	4,590,000
California	1,750,000	7.25	67	12,687,500	4,186,875
United States	38,864,931	6.60	60.6	256,294,750	100,959,118
Pulled wool			30	42,000,000	29,400,000
Total product, 1907				298,294,750	130,359,118

Wholesale prices of wool per pound, 1903–1907.

Date.	Boston.		New York.		Philadelphia.		St. Louis.	
	XX Ohio, washed.		XX Ohio.		XX Ohio, washed.		Best tub-washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	32	32½	31	32	31	32	29	29
February	31	33	31	32	31	32	29	29
March	31	32	31	32	31	32	28	29
April	31	32	31	32	31	32	27	28½
May	30	32	30	33	31	32	27	28½
June	31	34	30	31	30	31	28	29
July	33	34	30	31	32	33	29	29½
August	33	35	31	33	32	33	29	29½
September	34	35	28	32	32	33	30	30
October	34	35	28	32	33	34	30	30½
November	34	35	28	32	33	34	30½	31
December	34	35	28	32	33	34	30½	30½
1904.								
January	33½	34	28	32	33	33	30½	30½
February	33	34	28	32	33	33	30½	31
March	33	34	28	32	33	33	30½	31
April	32	34	28	32	33	33	30½	31
May	32	33	28	32	32½	32½	30½	32
June	32	34	28	32	31½	31½	32	33
July	34	35	28	35	31½	33	33	34½
August	34	35	32	35	33	33	35	35
September	34	35	34	35	33	33	35	36
October	34	35	32	35	33	33	34½	36½
November	35	36	32	35	33	33½	37	40
December	34	36	32	35	33½	33½	40	41
1905.								
January	34	35	32	35	34	36	40	41
February	34	35	32	35	34	35	39	41
March	34	35	31	34	34	35	37	38
April	34	35	31	36	34	35	37	39½
May	34	36	32	36	34	36	39	43
June	36	37	32	36	34	36	41	42½
July	35	37	32	39	35	36	41	42
August	36	37	35	39	35	36	41½	41½
September	36	37	35	38	35	36	42	42
October	36	37	35	38	34	35	42	42½
November	35	36	34	38	34	35	41	42
December	35	36	35	38	34	35	41	41½
1906.			(a)					
January	34	36	35	38	34	35	33	35
February	34	34½	35	38	34	35	31	35
March	34	34½	35	38	34	35	36	38
April	34	34½	35	38	34	35	36	38
May	34	34½	35	38	34	35	38	40
June	34	34½	35	38	34	34½	38	39
July	34	35	35	38	33½	34	38	38½
August	34	35	35	38	33½	34	37	38½
September	34	34½	35	38	33½	34	37	38
October	33½	34½	35	38	33½	34	37	38
November	33½	34	35	38	33	34	37	37½
December	34	34½	35	38	33	34	38	38
1907.								
January	34	34½	35	39	33½	34	38	38
February	34	34½	35	39	33½	34	38	38
March	34	34½	35	39	33½	34	37	38
April	34	34½	35	39	33½	34	36	38
May	33	34½	32	39	33½	34	36	37
June	33	34	31	38	33	34	36	37½
July	33	34	31	34	33	34	36	36½
August	34	35	32	35	33	34	36	36½
September	34	35	32	35	33	34	35	36
October	34	35	32	35	33	34	36	36
November	34	35	32	35	33	34	33	35
December	34	35	32	35	33	34	33	33

a XX washed.

Range of prices per pound of wool in Boston, monthly, 1903–1907.[a]

Date.	Ohio fine, unwashed.		Indiana quarter-blood, unwashed.		Ohio XX, washed.		Ohio, No. 1, washed.		Ohio Delaine, washed.		Michigan X, washed.[b]	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
January	22	23	23½	24	32	32½	31	32	34	35	27	27½
February	22	23	24	25	31	33	31	33	34	35	27	27½
March	22	23	22	24	31	32	31	32	33½	34	26	27
April	20	22	22	23½	31	32	30	31	33½	34	26	26½
May	20	22	22	23½	30	32	29	31	33½	35	25	26
June	21	24	22	25	31	34	30	33	34	37	25	26
July	23	24	23	25	33	34	32	33	36	37	21	22
August	23	25	24	25	33	35	32	33	36	37	21½	22
September	24	25	24	25	34	35	32	33	36	37	21	22
October	24	25	24	25	34	35	32	34	36	37	21	22
November	24	25	24	25	34	35	33	34	35	37	21	22
December	24	25	24	25	34	35	33	34	35	36	21	22
1904.												
January	23	24	24	25	33½	34	32	33	35	36	21	22
February	22	24	24½	25½	33	34	32	33	35	36	20	22
March	22	24	24½	25½	33	34	32	33	35	36	20	21
April	22	23	25	25½	32	34	30	32	34	35	19	21
May	22	23	24	25	32	33	30	32	34	35	19	20
June	22	23	24	27	32	34	30	33	34	36	19	22
July	21	24	27	30	34	35	33	34	35	36	21	22
August	24	25	28	30	34	35	33	34	35½	36	21	22
September	24	25	28	29	34	35	33	34	35½	36	21	22
October	23	25	28	30	34	35	33	35	35½	36	21	22
November	23	25	30	32	35	36	35	38	35½	38	21	22
December	24	25	31	33	34	36	37	40	37	38	21	22
1905.												
January	24	25	31	33	34	35	38	39	37	38	21	22
February	24	25	31	32	34	35	38	39	36	38	21	22
March	23	25	30	32	34	35	36	37	36	37	20	22
April	23	24	30	31	34	35	36	37	36	37	20	21
May	23	27	30	35	34	36	36	38	36	39	20	25
June	26	30	34	36	36	37	37	42	39	40	25	27
July	27	28	33	37	35	37	39	43	38	40	25	26
August	27	28	34	36	36	37	40	42	39	40	25	27
September	27	28	34	35	36	37	40	42	39	40	25	26
October	27	28	34	35	36	37	41	42	37	39	25	26
November	27	28	34	35	35	36	41	42	36½	37	25	26
December	27	28	33	34	35	36	39	42	36½	37	25	26
1906.												
January	26	28	33	34	34	36	39	40	36½	37	25	26½
February	26	26½	32	34	34	34½	39	40	36½	37	26	26½
March	24	26	32	32½	34	34½	39	40	36½	37	24	25
April	24	25	32	32½	34	34½	39	40	36½	37	24	25
May	24	26	32	32½	34	34½	37	40	36½	37	24	25
June	24	25	32	32½	34	34½	37	38	36½	37	24	25
July	24	25	32	34	34	35	37	38	36½	37	24	25
August	24	26	33	34	34	35	40	41	36	37	24	26
September	25	26	33	34	34	34½	40	41	36	37	25	26
October	24	26	30	34	33½	34½	40	41	35½	37	24	26
November	24	25	30	31½	33½	34	40	41	35½	36½	24	25
December	24	25	31	32	34	34½	40	41	36½	37½	24	25
1907.												
January	25	27	32	34	34	34½	40	41	37	38	24	25
February	26	27	32	34	34	34½	40	41	37	38	25	25
March	26	27	31	33	34	34½	39	40	37	38	25	25
April	26	27	31	33	34	34½	39	40	37	38	24	25
May	25	27	30	33	33	34½	38	40	36	38	24	25
June	25	26	30	31	33	34	38	39	36	37½	23	24
July	25	28	30	31	33	34	38	39	37	38	24	25
August	26	27	29	31	34	35	39	40	38	39	24	26
September	27	27	29	31	34	35	39	40	38	39	25	26
October	27	27	29	30	34	35	39	40	38	39	24	26
November	26	27	29	30	34	35	39	40	38	39	24	25
December	26	27	29	30	34	35	39	40	38	39	24	25

[a] Furnished by Commercial Bulletin, Boston.
[b] Since June 12, 1903, the standard quotation has been Michigan fine unwashed.

Range of prices per pound of wool in Boston, monthly, 1903–1907—Continued.

Date.	Fine selected Territory, staple scoured.		Fine medium Territory, clothing scoured.		Texas, 12 months, scoured.		Fine free fall, Texas or California scoured.		Pulled, A super, scoured.		Pulled, B super, scoured.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
January	56	60	54	58	57	60	46	48	44	46	40	42
February	55	58	52	56	55	58	45	48	43	46	40	43
March	54	56	52	54	55	57	45	46	42	45	39	42
April	54	55	52	53	55	57	45	46	40	44	39	41
May	52	55	50	53	53	57	45	46	40	45	39	42
June	52	55	50	53	53	57	45	48	42	44	40	42
July	53	55	52	53	55	57	46	48	43	47	40	44
August	54	56	52	53	55	57	46	48	45	47	43	44
September	55	56	52	53	55	57	46	48	44	47	42	44
October	55	56	52	53	55	57	46	48	44	47	42	43
November	53	56	51	53	55	56	45	48	44	47	40	43
December	53	55	51	52	55	56	44	46	43	45	40	42
1904.												
January	50	52	50	52	55	56	45	46	43	47	40	43
February	53	55	50	52	55	56	45	46	44	47	41	43
March	53	55	50	52	54	56	45	46	44	47	41	43
April	53	55	50	52	53	55	44	46	44	47	42	43
May	52	53	50	51	52	53	44	45	45	47	42	44
June	52	58	50	52	52	60	44	45	45	48	43	45
July	58	62	53	60	58	60	44	45	46	49	43	46
August	60	63	58	60	58	60	44	45	48	50	45	48
September	62	65	58	62	58	63	44	47	48	52	47	50
October	63	65	60	62	62	63	45	50	50	54	48	50
November	64	70	60	65	62	63	48	53	54	57	50	53
December	68	70	65	68	62	68	52	56	58	60	52	55
1905.												
January	68	70	62	63	65	68	55	56	58	60	53	55
February	65	70	60	63	63	68	54	56	57	60	52	55
March	65	68	60	62	63	65	54	56	55	60	52	54
April	65	70	60	63	63	68	54	56	55	60	52	54
May	68	74	62	67	67	72	54	56	58	65	52	58
June	73	76	65	70	70	75	54	60	58	62	55	58
July	73	78	67	70	74	76	57	63	58	62	55	58
August	76	78	67	72	74	76	62	63	60	63	56	60
September	76	78	68	72	74	76	62	63	62	63	58	60
October	76	78	68	72	74	76	62	63	62	63	57	60
November	76	78	66	70	74	76	62	63	62	63	55	57
December	76	78	66	70	74	76	62	63	62	63	54	56
1906.												
January	75	78	65	68	74	76	62	63	62	63	53	56
February	75	76	66	68	74	76	62	63	60	63	52	55
March	72	73	66	68	72	73	62	63	60	62	52	55
April	72	73	66	68	72	73	62	63	60	62	52	55
May	72	73	66	68	72	73	62	63	60	64	52	55
June	72	73	66	70	72	73	62	63	60	64	52	55
July	72	75	68	70	72	73	62	63	60	64	52	55
August	73	75	68	70	72	73	62	63	60	64	51	55
September	73	75	68	70	72	73	58	63	60	64	50	55
October	70	75	65	69	72	73	58	60	57	64	49	55
November	70	72	65	67	72	73	58	60	56	60	47	53
December	70	73	66	68	72	73	58	62	53	59	47	53
1907.												
January	72	75	66	70	72	75	60	62	56	58	46	52
February	72	75	68	70	73	75	60	62	56	60	47	52
March	72	73	68	73	72	75	58	60	53	60	45	52
April	72	73	68	70	72	74	58	60	53	58	45	50
May	70	73	68	70	72	74	57	60	53	58	45	50
June	70	73	68	70	70	73	57	58	53	58	43	47
July	72	73	68	70	72	73	57	58	53	58	44	47
August	72	75	68	72	72	73	57	58	55	58	43	47
September	72	73	70	72	72	73	57	58	52	58	43	45
October	72	73	70	72	72	73	57	58	52	57	43	45
November	72	73	70	72	72	73	52	58	50	57	42	45
December	70	73	68	72	72	73	50	55	45	55	38	45

International trade in wool, 1902–1906.[a]

EXPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Algeria	Jan. 1	9,634,557	16,689,429	21,519,315	22,501,034	[b] 22,501,034
Argentina	Jan. 1	436,374,060	425,467,795	371,697,065	421,098,234	328,731,186
Australia	Jan. 1	335,953,936	324,563,030	395,130,825	437,167,965	480,242,885
Belgium	Jan. 1	45,628,389	47,107,979	42,081,470	40,023,199	40,098,225
British India	Apr. 1	28,038,050	33,326,503	38,602,768	42,694,706	46,003,250
Cape of Good Hope	Jan. 1	96,957,471	79,698,393	78,411,050	74,311,616	86,579,383
France	Jan. 1	74,786,076	70,346,942	74,093,959	72,227,925	79,399,693
Netherlands	Jan. 1	36,231,009	42,214,830	33,032,572	30,778,915	28,099,091
New Zealand	Jan. 1	160,419,023	155,128,381	126,834,850	145,257,159	159,849,207
Peru	Jan. 1	8,182,423	9,257,920	7,951,060	9,944,067	[b] 9,944,067
Russia	Jan. 1	29,354,903	30,071,056	35,298,276	32,423,264	[c] 41,060,254
Spain	Jan. 1	25,835,165	25,096,103	28,808,285	43,825,033	[c] 24,164,006
Turkey [d]	Mar. 1	40,621,737	40,621,737	40,621,737	40,621,737	40,621,737
United Kingdom	Jan. 1	37,204,800	35,950,200	37,858,500	35,251,500	29,808,700
Uruguay	Jan. 1	95,637,488	92,124,262	99,148,322	72,917,218	[b] 72,917,218
Other countries	....	160,652,000	179,655,000	193,824,000	222,833,421	[c] 193,044,779
Total	....	1,621,511,087	1,607,319,560	1,624,914,054	1,743,876,993	1,683,064,715

IMPORTS.

Country.	Year beginning—	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	65,039,215	61,887,928	62,501,474	59,692,125	52,889,543
Belgium	Jan. 1	122,180,634	119,472,000	117,205,945	140,786,550	134,875,551
British India	Apr. 1	7,452,021	7,431,310	8,807,926	18,786,391	21,690,933
Canada	July 1	7,994,702	7,339,369	7,617,211	6,311,837	[c] 6,310,179
France	Jan. 1	519,935,691	524,434,503	466,088,531	480,776,007	537,763,155
Germany [e]	Jan. 1	416,038,627	425,726,618	413,781,976	446,726,304	439,027,543
Japan	Jan. 1	5,505,283	7,282,080	21,281,995	14,085,106	13,411,907
Netherlands	Jan. 1	45,481,019	49,996,876	42,618,842	37,692,892	39,242,593
Russia	Jan. 1	65,114,737	71,607,060	50,207,084	60,795,682	[c] 42,829,781
Sweden	Jan. 1	9,809,111	10,164,381	10,471,454	10,114,559	10,807,835
Switzerland	Jan. 1	10,929,200	10,882,200	11,528,600	10,981,002	14,553,151
United Kingdom	Jan. 1	392,752,036	351,928,151	344,758,631	369,465,005	409,403,772
United States	July 1	177,137,796	173,742,834	249,135,746	201,688,668	203,847,545
Other countries	....	58,692,000	63,556,000	60,020,000	49,259,674	[c] 48,881,068
Total	....	1,904,062,072	1,885,451,310	1,866,025,415	1,907,161,802	1,975,534,556

[a] See "General note," page 615.
[b] Year preceding.
[c] Preliminary.
[d] Exports for 1899, the latest available data.
[e] Not including free ports prior to March 1, 1906.

SWINE.

Number, farm value, and exports of swine, 1867–1908.

Year.	On farms January 1.			Exports for year ending June 30.		
	Number.	Price per head.	Farm value.	Number.	Value.	Average export price.
1867	24,693,534	$4.03	$99,637,016	3,577	$40,092	$11.21
1868	24,317,258	3.29	79,975,643	1,399	18,447	13.19
1869	23,316,476	4.65	108,430,534	....	....	....
1870	26,751,400	5.80	155,108,222	12,058	189,753	15.74
1871	29,457,500	5.61	165,311,698	8,770	61,390	7.00
1872	31,796,300	4.01	127,453,285	56,110	548,153	9.77
1873	32,632,050	3.67	119,631,880	99,720	787,402	7.90
1874	30,860,900	3.98	122,695,085	158,581	1,625,837	10.25
1875	28,062,200	4.80	134,581,364	64,979	739,215	11.38
1876	25,726,800	6.00	154,251,110	68,044	670,042	9.85
1877	28,077,100	5.66	158,873,410	65,107	699,180	10.74
1878	32,262,500	4.85	156,577,228	29,284	267,259	9.13
1879	34,766,100	3.18	110,507,788	75,129	700,262	9.32
1880	34,034,100	4.28	145,781,515	83,434	421,089	5.05
1881	36,247,683	4.70	170,535,435	77,456	572,138	7.39
1882	44,122,200	5.97	263,543,195	36,368	509,651	14.01
1883	43,270,086	6.75	291,951,221	16,129	272,516	16.90
1884	44,200,893	5.57	246,301,139	46,382	627,480	13.53
1885	45,142,657	5.02	226,401,683	55,025	579,183	10.53
1886	46,092,043	4.26	196,569,894	74,187	674,297	9.09
1887	44,612,836	4.48	200,043,291	75,383	564,753	7.49
1888	44,346,525	4.98	220,811,082	23,755	193,017	8.13
1889	50,301,592	5.79	291,307,193	45,128	356,764	7.91
1890	51,602,780	4.72	243,418,336	91,148	909,042	9.97
1891	50,625,106	4.15	210,193,923	95,654	1,146,630	11.99
1892	52,398,019	4.60	241,031,415	31,963	364,081	11.39
1893	46,094,807	6.41	295,426,492	27,375	397,162	14.51
1894	45,206,498	5.98	270,384,626	1,553	14,753	9.50
1895	44,165,716	4.97	219,501,267	7,130	72,424	10.16
1896	42,842,759	4.35	186,529,745	21,049	227,297	10.80
1897	40,600,276	4.10	166,272,770	28,751	295,998	10.30
1898	39,759,993	4.39	174,351,409	14,411	110,487	7.67
1899	38,651,631	4.40	170,109,743	33,031	227,241	6.88
1900	37,079,356	5.00	185,472,321	51,180	394,813	7.71
1901	56,982,142	6.20	353,012,143	22,318	238,465	10.68
1902	48,698,890	7.03	342,120,780	8,368	88,330	10.56
1903	46,922,624	7.78	364,973,688	4,031	40,923	10.15
1904	47,009,367	6.15	289,224,627	6,345	53,780	8.48
1905	47,320,511	5.99	283,254,978	44,496	416,692	9.36
1906	52,102,847	6.18	321,802,571	59,170	630,998	10.66
1907	54,794,439	7.62	417,791,321	24,262	309,440	12.75
1908	56,084,000	6.05	339,030,000	....	....	....

Number, average price, and farm value of swine in the United States January 1, 1908.

State or Territory.	Number.	Average price per head Jan. 1.	Farm value Jan. 1.	State or Territory.	Number.	Average price per head Jan. 1.	Farm value Jan. 1.
Maine	67,000	$8.75	$586,000	North Dakota	233,000	$7.50	$1,748,000
New Hampshire	52,000	9.25	481,000	South Dakota	903,000	7.00	6,321,000
Vermont	99,000	8.15	807,000	Nebraska	4,243,000	6.25	26,519,000
Massachusetts	70,000	10.25	718,000	Kansas	2,663,000	5.90	15,712,000
Rhode Island	13,000	10.00	130,000	Kentucky	1,274,000	4.60	5,860,000
Connecticut	47,000	10.50	494,000	Tennessee	1,502,000	4.65	6,984,000
New York	669,000	8.90	5,954,000	Alabama	1,251,000	4.60	5,755,000
New Jersey	155,000	10.00	1,550,000	Mississippi	1,316,000	4.50	5,922,000
Pennsylvania	990,000	7.80	7,722,000	Louisiana	669,000	4.50	3,010,000
Delaware	46,000	7.50	345,000	Texas	3,147,000	5.25	16,522,000
Maryland	293,000	6.35	1,861,000	Oklahoma	1,588,000	5.33	8,464,000
Virginia	798,000	5.75	4,588,000	Arkansas	1,127,000	3.80	4,283,000
West Virginia	379,000	5.75	2,179,000	Montana	66,000	10.00	660,000
North Carolina	1,357,000	5.60	7,599,000	Wyoming	18,000	9.25	166,000
South Carolina	678,000	5.70	3,865,000	Colorado	150,000	8.00	1,200,000
Georgia	1,599,000	5.50	8,794,000	New Mexico	26,000	7.00	182,000
Florida	399,000	3.75	1,496,000	Arizona	18,000	8.00	144,000
Ohio	2,559,000	6.50	16,634,000	Utah	61,000	7.50	458,000
Indiana	3,159,000	6.20	19,586,000	Nevada	15,000	10.00	150,000
Illinois	4,672,000	6.60	30,835,000	Idaho	130,000	7.00	910,000
Michigan	1,388,000	6.60	9,161,000	Washington	182,000	7.75	1,410,000
Wisconsin	1,910,000	7.00	13,370,000	Oregon	279,000	6.25	1,744,000
Minnesota	1,267,000	7.10	8,996,000	California	551,000	7.20	3,967,000
Iowa	8,413,000	6.50	54,684,000				
Missouri	3,593,000	5.15	18,504,000	United States	56,084,000	6.05	339,030,000

Wholesale prices of live hogs per 100 pounds, 1903–1907.

Date.	Cincinnati. Packing, fair to good.		St. Louis. Mixed packers.		Chicago.		Omaha.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
January	$6.25	$6.95	$6.15	$6.95	$5.00	$7.00	$6.00	$6.85
February	6.70	7.30	6.60	7.30	5.30	7.55	6.35	7.20
March	7.05	7.75	6.95	7.60	6.00	7.85	6.75	7.55
April	6.70	7.45	6.50	7.40	6.30	7.65	6.60	7.40
May	5.75	6.85	5.80	7.05	5.10	7.15	5.50	6.90
June	5.70	6.25	5.50	6.20	5.25	6.35	5.50	6.20
July	5.15	5.90	5.30	5.95	4.60	6.20	4.90	5.65
August	5.40	6.05	5.20	5.90	4.50	6.15	4.92½	5.80
September	5.80	6.35	5.55	6.20	4.85	6.45	5.05	6.00
October	5.10	6.20	5.30	6.25	4.00	6.50	4.80	5.85
November	4.15	5.35	4.50	5.50	3.75	5.50	4.10	5.25
December	4.25	4.95	4.20	4.85	3.80	4.90	4.15	4.70
1904.								
January	4.75	5.25	4.65	5.25	3.85	5.20	4.20	5.00
February	4.85	5.85	4.70	5.80	3.90	5.80	4.50	5.60
March	5.35	6.00	5.20	5.75	4.00	5.82½	4.60	5.40
April	4.90	5.50	4.75	5.67½	3.75	5.30	4.50	5.17½
May	4.50	5.00	4.55	4.90	3.70	4.95	4.20	4.77½
June	4.55	5.55	4.57½	5.50	4.00	5.47½	4.27½	5.27½
July	5.25	5.95	5.10	5.75	4.70	5.90	4.50	5.37½
August	5.20	5.85	5.10	5.72½	4.60	5.80	4.65	5.40
September	5.55	6.25	5.30	6.25	4.70	6.37½	5.00	6.05
October	5.00	6.10	4.90	6.30	4.40	6.27½	4.92½	5.85
November	4.45	5.20	4.50	5.17½	3.65	5.25	4.45	5.00
December	4.35	4.90	4.25	4.85	3.60	4.87½	4.25	4.65
1905.								
January	4.60	4.95	4.75	5.02	3.90	5.00	4.30	4.85
February	4.80	5.35	4.97	5.20	4.10	5.15	4.40	5.00
March	5.00	5.65	5.25	5.57	4.15	5.55	4.50	5.25
April	5.25	5.80	5.60	5.70	4.50	5.72½	5.10	5.40
May	5.30	5.60	5.40	5.57	4.60	5.65	5.00	5.37½
June	5.30	5.55	5.42	5.65	4.50	5.65	4.90	5.35
July	5.45	6.20	5.75	6.20	4.80	6.15	5.05	5.70
August	5.90	6.35	6.30	6.35	5.25	6.45	5.50	6.10
September	5.15	6.25	5.60	6.00	4.40	6.20	4.85	5.75
October	4.95	5.70	5.15	5.55	4.40	5.80	4.75	5.37½
November	4.80	5.15	4.95	5.12½	4.20	5.25	4.50	5.00
December	4.80	5.45	5.00	5.30	4.50	5.35	4.65	5.00
1906.								
January	5.30	5.80	5.10	5.45	4.60	5.70	4.85	5.50
February	5.65	5.45	5.35	6.20	5.10	6.40	5.25	6.20
March	6.30	6.75	6.10	6.45	5.50	6.55	5.85	6.37½
April	6.35	6.75	6.25	6.65	5.15	6.82½	6.10	6.55
May	6.25	6.62	6.22	6.57	5.10	6.67½	6.10	6.45
June	6.30	6.85	6.20	6.75	5.25	6.85	6.10	6.60
July	6.65	6.95	6.55	6.97	5.60	7.00	6.15	6.75
August	6.00	6.72	6.05	6.67	5.10	6.80	5.45	6.45
September	6.10	6.80	6.12	6.67	5.25	6.80	5.40	6.45
October	6.10	6.80	6.15	6.70	5.16	6.85	5.92½	6.50
November	6.10	6.50	6.07	6.42	5.20	6.50	5.80	6.27½
December	6.10	6.55	5.95	6.45	5.30	6.55	5.90	6.35
1907.								
January	6.40	7.00	6.20	6.87	5.50	6.97½	6.15	6.90
February	6.80	7.40	6.65	7.22	6.00	7.25	6.67½	7.05
March	6.25	7.25	6.07	7.15	5.50	7.05	6.00	6.90
April	6.50	6.90	6.50	6.85	5.90	6.90	6.20	6.55
May	6.25	6.72	6.25	6.65	5.70	6.65	5.77½	6.50
June	5.75	6.30	5.87	6.47	5.40	6.42½	5.70	6.20
July	5.75	6.55	5.85	6.45	5.20	6.65	5.50	6.30
August	6.10	6.85	5.85	6.80	5.20	6.70	5.35	6.25
September	6.25	6.90	6.00	6.75	4.75	7.00	5.40	6.35
October	5.90	7.10	6.30	7.00	4.00	7.05	5.25	6.50
November	4.15	6.25	4.00	6.45	3.10	6.33½	3.80	5.75
December	4.25	5.35	4.25	5.30	3.50	5.25	4.10	4.80

MEAT.

Per capita consumption of meat, by principal countries.

[Dressed weight, as far as domestic slaughter is concerned, unless otherwise stated.]

Country.	Department of Agriculture and other authorities.	Royal Statistical Society, 1902.	Ostertag, for 1890.[a]	Mulhall, published in 1899.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Argentina				140
Austria-Hungary			64	
Australian Commonwealth		262.6	246	[b] 208
Belgium		70		
Belgium and the Netherlands			69	
Canada				129
Cuba	124			
Denmark		76		
France	[c] 78.9	80	74	75
Germany		99	70	[d] 74 [e] 66
1907	[f] 103.8			
1906	[f] 98.8			
1905	[f] 101.1			
1904	[f] 108.5			
1894 (Lichtenfeld)	[f] 88			
Great Britain			105	[g] 115
Greece				68
Italy	[h] 46.5		23	27
Netherlands				48
New Zealand		212.5		
Poland (Russian)				62
Portugal				44
Russia			48	[i] 50
Spain			49	
Sweden		62		
Sweden and Norway			87	74
Switzerland				75
United Kingdom		[j] 121.3		[g] 108 [k] 93
United States:				
Dressed	185.8	[l] 150	120	141
Dressed and extra edible parts	220.5			
Edible dressed and extra edible parts	182.6			

[a] Quoted by Ostertag as the estimate of the "Statistisches Amt" in England for 1890. Handbook of Meat Inspection, p. 3.
[b] Including New Zealand.
[c] Imbart de la Tour.
[d] 1899.
[e] 1883.
[f] Official, under meat-inspection law.
[g] 1895.
[h] Director-general of public health.
[i] Excluding Poland.
[j] 1898–1902.
[k] 1875.
[l] 1885. Stated to be on authority of U. S. Department of Agriculture.

TRANSPORTATION RATES.

Quotations of ocean freight rates on corn, wheat, cotton, and lard from United States ports to Liverpool during 1907.

Article and port.	Mean for month. Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean for year.
Corn and wheat (per 60 lbs.):	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Boston	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.26	3.68	3.68	5.88	6.30	3.74
New York	3.61	3.55	3.02	2.62	2.75	3.15	3.15	3.99	3.68	3.80	5.78	5.38	3.71
Baltimore	3.54	4.07	4.46	3.41	2.36	2.36	3.15	4.20	4.72	3.94	6.30	6.30	4.07
New Orleans	7.35	7.35	7.35	7.35	7.35	7.35	7.14	6.30	6.30	6.30	7.35	7.35	7.07
Galveston	5.44	7.31	6.94	6.47	6.19	7.31	7.31	6.00	6.94	6.19	7.31	7.31	6.73
Cotton (per 100 lbs.):													
Boston	12.00	12.00	11.80	11.00	11.00	11.00	11.00	11.00	15.00	15.00	17.80	17.80	13.03
New York	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	20.00	20.00	26.00	20.62	18.55
Baltimore	15.00	15.00	15.00	15.00	18.30	15.00	15.00	19.20	22.00	22.00	23.40	25.00	18.32
New Orleans	36.00	36.75	37.00	35.50	33.00	33.00	33.00	33.00	35.67	38.40	39.33	40.00	35.89
Galveston	33.31	34.78	35.00	30.00	32.00	32.00	30.00	32.00	35.00	35.30	39.00	38.00	33.87
Lard, small packages (per 100 lbs.):													
Boston	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88
New York	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88
Baltimore	18.28	18.28	18.28	18.28	18.28	18.28	18.28	18.28	18.28	18.28	18.28	18.28	18.28
New Orleans	25.00	25.00	25.00	25.00	23.80	23.00	23.00	23.00	25.00	25.00	27.00	27.00	24.73
Galveston	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	23.00	23.00	23.00	21.50

Live stock and dressed meats, Chicago to New York by rail: Mean rates, in cents, per 100 pounds.

Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs. Refrigerator cars.	Dressed hogs. Common cars.
1881	35	31	61	60	56		
1882	36	29	53	60	57		
1883	40	32	50	60	64		
1884	31	28	44	60	51		
1885	31	26	43	60	54		
1886	33	30	42	60	61	53	48
1887	33	32	40	60	62	59	54
1888	22	26	31	60	46	46	44
1889	25	30	30	60	47	47	45
1890	23	28	30	60	39	39	39
1891	27	30	30	60	45	45	45
1892	28	28	30	60	45	45	45
1893	28	20	30	60	45	45	45
1894	28	30	30	60	45	45	45
1895	28	30	30	60	45	45	45
1896	28	30	30	60	45	45	45
1897	28	30	30	60	45	45	45
1898	28	30	30	60	45	45	45
1899 [a]	25	25	25	60	40.0	40.0	40.0
1900	28	30	30	60	45.0	45.0	45.0
1901	28	30	30	60	42.9	42.9	42.9
1902	28	30	30	60	41.2	41.2	41.2
1903	28	30	30	60	45.0	45.0	45.0
1904	28	30	30	60	45.0	45.0	45.0
1905	28	30	30	60	45.0	45.0	45.0
1906	28	30	30	60	45.0	45.0	45.0
1907	28	30	30	60	45.0	45.0	45.0
Annual mean.							
1881–1885	34.6	29.2	50.2	60	56.4		
1886–1890	27.2	29.2	34.6	60	51.0	48.8	46.0
1891–1895	27.8	27.6	30.0	60	45.0	45.0	45.0
1896–1900	27.4	29.0	29.0	60	44.0	44.0	44.0
1901–1905	28.0	30.0	30.0	60	43.8	43.8	43.8

[a] Rates did not go into effect until February 1, 1899. Up to that time the 1898 rates governed.

Meats, packed, Cincinnati to New York by rail: Mean rates, in cents, per 100 pounds.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
1881	35	35	35	30.5	30.5	25.7	21.5	21.5	21.5	21.5	21.5	21.5	26.73
1882	......	21.5	24.3	26	26	26	26	26	26	26	26	30.5	25.85
1883	30.5	30.5	30.5	29.2	26	26	26	26	26	26	26.7	30.5	27.83
1884	30.5	30.5	23.3	17.5	17.5	18.4	23	26	26	26	26	26	24.22
1885	24.4	21.5	20	20.6	18.5	17.5	17.5	21.5	21.5	21.5	22.8	26	21.10
1886	26	26	26	26	26	26	26	26	26	26	26	27.7	26.14
1887	30.5	30.5	30.5	26	26	26	26	26	26	26	26	26	27.12
1888	28	28.5	26.3	26	26	26	19.9	17.3	15.5	18.8	21.5	23.6	23.12
1889	26	26	26	26	26	26	26	26	26	26	26	26	26
1890	26	26	26	26	26	26	26	24.8	20	20	20	20	23.90
1891	20	24.3	26	26	26	26	26	26	26	26	26	26	25.36
1892	26	26	26	26	26	25.7	21.5	21.5	21.5	21.5	21.5	21.5	23.72
1893	21.5	23.7	26	26	26	26	26	26	26	26	26	26	25.43
1894	26	26	26	26	26	26	26	26	26	26	26	26	26
1895	26	26	26	26	26	26	26	26	26	26	26	26	26
1896	26	26	26	26	26	26	26	26	26	26	26	26	26
1897	26	26	26	26	26	26	26	26	26	26	26	26	26
1898	26	26	26	26	26	26	26	26	26	26	26	26	26
1899	26	26	26	26	26	26	26	26	26	21.5	21.5	21.5	24.88
1900	26	26	26	26	26	26	26	26	26	26	26	26	26
1901	26	26	26	26	26	26	26	26	26	26	26	26	26
1902	26	26	26	26	26	26	26	26	26	26	26	26	26
1903	26	26	26	26	26	26	26	26	26	26	26	26	26
1904	26	26	26	26	26	26	26	26	26	26	26	26	26
1905	26	26	26	26	26	26	26	26	26	23	21.5	21.5	25
1906	26	26	26	26	26	26	26	26	26	26	26	26	26
1907	26	26	26	26	26	26	26	26	26	26	26	26	26
Annual mean.													
1881-1885	30.1	27.8	26.6	24.8	23.7	22.7	22.8	24.2	24.2	24.2	24.6	26.9	25.1
1886-1890	27.3	27.4	27	26	26	26	24.8	24	22.7	23.4	23.9	24.7	25.3
1891-1895	23.9	25.2	26	26	26	25.9	25.1	25.1	25.1	25.1	25.1	25.1	25.3
1896-1900	26	26	26	26	26	26	26	26	26	25.1	25.1	25.1	25.8
1901-1905	26	26	26	26	26	26	26	26	26	25.4	25.1	25.1	25.8

Compressed cotton, by rail: Mean rates, in cents, per 100 pounds.

Year.	From New Orleans [a] to— Boston.	From New Orleans [a] to— New York.	From New Orleans [a] to— Philadelphia.	From New Orleans [a] to— Baltimore.	From Memphis to— New York.	From Memphis to— Boston.
1881	58	53	54	54	66	71
1882	53	48	51	51	61	66
1883	60	55	53	52	72	77
1884	60	55	53	52	54	59
1885	60	55	53	52	56	58
1886	52	47	45	44	53	58
1887	50	45	43	42	53	58
1888	50	45	43	42	47	52
1889	52	47	45	44	50.5	55
1890	55	50	50	50	50.5	55
1891	55	50	50	50	50.5	55
1892	55	50	50	50	50.5	55
1893	55	50	50	50	47	52
1894	51	50	50	50	50.5	55.5
1895	53	48	48	48	50.5	55.5
1896	55	50	50	50	50.5	55.5
1897	55	50	50	50	50	55
1898	55	50	50	50	47	52
1899	52	47	47	47	48	53
1900	55	50	50	50	50.5	55.5
1901	55	50	50	50	50.5	55.5
1902	55	50	50	50	50.5	55.5
1903	55	50	50	50	50.5	55.5
1904	55	50	50	50	50.5	50.5
1905	55	50	50	50	40.5	45.5
1906	55	50	50	50	40.5	45.5
1907	55	50	50	50	40.5	45.5
Annual mean.						
1881-1885	58.2	53.2	52.8	52.2	61.8	66.2
1886-1890	51.8	46.8	45.2	44.4	50.8	55.6
1891-1895	53.8	49.6	49.6	49.6	49.8	54.6
1896-1900	54.4	49.4	49.4	49.4	49.2	54.2
1901-1905	55	50	50	50	48.5	52.5

[a] These rates are mainly used for basing purposes.

Corn and wheat: Mean proportional export freight rates per 100 pounds from Kansas City and Omaha to leading Gulf and Atlantic ports during the calendar years 1905, 1906, and 1907.

Destination and article.	From Kansas City.			From Omaha.		
	1905.	1906.	1907.	1905.	1906.	1907.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
New Orleans:						
Corn	14.8	[a] 16.5	16.9	15.8	[a] 17.5	17.9
Wheat	[b] 16.1	[a] 17.1	17.9	[b] 17.4	[a] 18.1	18.9
Galveston:						
Corn	14.8	16.5	16.9	15.8	17.5	17.9
Wheat	[b] 16.1	17.1	17.9	[b] 17.4	18.1	18.9
Boston:						
Corn	22.2	23.4	23.4	22.2	23.4	23.4
Wheat	[c] 25.0	[d] 21.5	24.4	[c] 25.0	[d] 21.5	24.4
New York:						
Corn	22.2	23.4	23.4	22.2	23.4	23.4
Wheat	[c] 25.0	[d] 21.5	24.4	[c] 25.0	[d] 21.5	24.4
Philadelphia:						
Corn	21.2	22.4	22.4	21.2	22.4	22.4
Wheat	[c] 24.0	[d] 20.5	23.4	[c] 24.0	[d] 20.5	23.4
Baltimore:						
Corn	20.7	21.9	21.9	20.7	21.9	21.9
Wheat	[c] 23.5	[d] 20.0	22.9	[c] 23.5	[d] 20.0	22.9

[a] From April 25 to August 10, 1906, inclusive, rates used in computing this average include delivery on board ship.
[b] For July 25 to December 31, 1905, inclusive.
[c] For second half of 1905 only.
[d] Average based upon rates in force for two periods, amounting together to about 30 days.

Corn and wheat: Mean rates, in cents, per bushel, Chicago to New York.

Year.	Corn.			Wheat.		
	By lake and canal.[a]	By lake and rail.	By all rail.	By lake and canal.[a]	By lake and rail.	By all rail.
1875	....	11.34	19.5	....	12.09	20.89
1876	8.75	9.68	14.12	9.82	10.19	15.12
1877	9.59	13.42	18.03	11.09	14.75	19.56
1878	8.83	10.45	16.39	9.96	11.99	17.56
1879	10.49	12.2	14.56	11.87	13.13	17.74
1880	13.41	14.43	17.48	13.13	15.8	19.8
1881	7.77	9.42	13.4	8.67	10.49	14.4
1882	6.72	10.28	13.5	7.23	10.91	14.47
1883	8.03	11	15.12	9.01	11.63	16.2
1884	6.55	8.5	12.32	7	10	13.2
1885	6.3	8.01	12.32	6.54	9.02	13.2
1886	8.45	11.2	14	9.10	12	15
1887	8.5	11.2	14.7	9.5	12	15.75
1888	6.71	10.26	13.54	7.05	11.14	14.5
1889	6.32	8.19	12.6	6.92	8.97	15
1890	5.93	7.32	11.36	6.76	8.52	14.3
1891	6.32	7.53	14	6.95	8.57	15
1892	5.95	7.21	12.96	6.45	7.59	13.8
1893	7.18	7.97	13.65	7.66	8.48	14.63
1894	4.93	6.5	12.32	5.11	7	13.2
1895	4.50	6.4	10.29	4.86	6.96	11.89
1896	5.75	6.15	10.5	6.19	6.61	12
1897	4.53	6.92	11.43	5.22	7.42	12.5
1898	[b] 3.81	4.41	9.8	[b] 4.45	4.91	12
1899	[b] 5.08	5.83	10.08	[b] 5.81	6.63	11.6
1900	[b] 4.07	4.72	9.19	[b] 4.49	5.1	9.96
1901	[b] 4.61	5.16	9.21	[b] 5.11	5.54	9.88
1902	[b] 4.83	5.51	9.94	[b] 5.26	5.89	10.62
1903	[b] 4.85	5.78	10.54	[b] 5.4	6.37	11.29
1904	[b] 3.63	4.82	10.38	[b] 4.73	5.50	11.12
1905	[b] 4.76	5.19	9.40	[b] 5.53	6.40	9.90
1906	[b] 5.51	5.72	9.52	[b] 6.03	6.35	10.20
1907	[b] 6.12	6.20	10.17	[b] 6.65	7.09	10.90
Annual mean.						
1876–1880	10.21	12.04	16.12	11.17	13.17	17.96
1881–1885	7.07	9.44	13.33	7.69	10.41	14.29
1886–1890	7.18	9.63	13.24	7.87	10.53	14.91
1891–1895	5.78	7.12	12.64	6.21	7.72	13.70
1896–1900	4.65	5.61	10.20	5.23	6.13	11.61
1901–1905	4.54	5.29	9.89	5.21	5.94	10.56

[a] Including Buffalo charges and tolls. [b] Excluding Buffalo charges.

Average annual freight rates, in cents, per ton per mile.

Year.[a]	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago. Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific R. R.	Louisville and Nashville R. R.	All railways in the United States.
1875	1.119	1.061	0.887	0.989	1.299	1.691	1.688	1.833	1.649	2.164	1.687	1.421
1876	.929	.972	.722	.841	1.062	1.587	1.693	1.798	1.438	2.211	1.638	1.217
1877	.954	.898	.813	.954	1.035	1.719	1.563	1.949	1.361	2.135	1.382	1.286
1878	.919	.960	.724	.914	.985	1.616	1.539	1.762	1.354	2.236	1.635	1.296
1879	.793	.779	.641	.823	.860	1.523	1.429	1.704	1.054	1.991	1.528	1.153
1880	.879	.836	.750	.918	.866	1.543	1.209	1.749	1.206	....	1.594	1.232
1881	.783	.805	.617	.857	.892	1.522	1.220	1.702	1.241	2.178	1.503	1.188
1882	.738	.749	.628	.874	.753	1.417	1.281	1.481	1.253	2.102	1.349	1.102
1883	.915	.786	.728	.881	.722	1.433	1.170	1.391	1.128	1.913	1.323	1.205
1884	.834	.719	.652	.804	.672	1.368	1.097	1.293	1.008	1.557	1.344	1.136
1885	.688	.656	.553	.695	.550	1.307	1.043	1.278	1.009	1.420	1.159	1.011
1886	.765	.659	.639	.755	.541	1.157	1.071	1.168	.961	1.266	1.079	.999
1887	.782	.687	.670	.730	.537	1.087	1.012	1.089	.946	1.213	1.075	.984
1888	.753	.716	.861	.723	.541	1.068	.964	1.020	.973	1.170	1.049	1.001
1889	.712	.644	.632	.685	.538	.839	.971	1.067	.525	1.166	.998	.922
1890	.730	.665	.644	.661	.561	.942	.995	.995	.898	1.138	.972	.941
1891	.740	.636	.630	.656	.525	.934	1.039	1.003	.980	1.131	.968	.895
1892	.699	.614	.602	.647	.518	.908	1.055	1.026	.973	1.080	.948	.898
1893	.701	.631	.599	.620	.511	.845	1.039	1.026	.949	1.033	.917	.878
1894	.733	.621	.587	.606	.478	.839	.989	1.037	.974	.970	.876	.860
1895	.726	.604	.567	.565	.425	.808	1.084	1.075	.994	.971	.831	.839
1896	.668	.606	.551	.563	.425	.745	1.017	1.003	.925	.957	.806	.806
1897	.679	.610	.538	.561	.419	.671	.958	1.008	.891	.962	.791	.798
1898	.606	.575	.530	.521	.369	.695	.966	.972	.866	.950	.743	.753
1899	.586	.539	.481	.469	.362	.688	.996	.937	.800	1.016	.727	.724
1900	.558	.588	.490	.504	.343	.650	.987	.930	.794	1.050	.752	.729
1901	.575	.615	.489	.562	.388	.619	1.000	.861	.723	1.042	.772	.750
1902	.632	.664	.503	.590	.402	.622	1.034	.840	.678	.979	.744	.757
1903	.634	.637	.519	.598	.475	.591	1.013	.865	.599	.973	.781	.763
1904	.664	.652	.523	.606	.470	.607	.944	.891	.677	.982	.791	.780
1905	.638	.645	.524	.604	.427	.587	.931	.881	.689	.897	.793	.766
1906	.625	.621	.516	.588	.420	.556	.930	.862	.639	.924	.803	.748
Annual mean.												
1876-1880	.895	.889	.730	.890	.962	1.598	1.487	1.792	1.283	[b]2.143	1.555	1.237
1881-1885	.792	.743	.636	.822	.718	1.409	1.162	1.429	1.128	1.834	1.336	1.128
1886-1890	.748	.674	.689	.711	.544	1.019	1.003	1.068	.861	1.191	1.035	.969
1891-1895	.720	.621	.597	.619	.491	.867	1.041	1.033	.974	1.037	.908	.874
1896-1900	.619	.584	.518	.524	.384	.690	.985	.970	.855	.987	.764	.762
1901-1905	.629	.643	.512	.592	.432	.605	.984	.868	.673	.975	.776	.763

[a] Beginning with 1888, the years mentioned end on June 30; prior to 1888 they cover different periods for different railways.
[b] Annual mean, 1876-1879.

Mean rates on grain, flour, and provisions, in cents, per 100 pounds, through from Chicago to European ports, by all rail to seaboard and thence by steamers, 1898-1907.

Shipped to—	Articles.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Liverpool	Grain	34.35	29.72	29.48	21.47	20.85	22.68	20.19	19.16	18.75	19.22
Do	Sacked flour	37.66	30.12	27.9	23.00	23.5	25.19	21.00	22.40	20.50	21.25
Do	Provisions	47.15	40.5	48.84	36.00	36.25	41.9	36.56	38.49	41.00	40.85
Glasgow	Grain	36.00	32.35	30.98	24.1	21.75	24.43	22.38	20.00	19.25	19.67
Do	Sacked flour	39.06	31.25	31.56	24.38	22.75	25.38	23.20	22.50	23.60	23.91
Do	Provisions	52.5	44.69	55.31	45.16	41.88	46.88	44.06	43.23	45.63	46.88
London	Grain	35.00	30.6	31.1	23.23	21.75	23.56	21.50	20.23	19.25	20.54
Do	Sacked flour	37.25	33.5	35.01	25.5	24.00	25.19	22.25	23.64	22.50	23.63
Do	Provisions	49.69	44.14	55.87	44.75	39.06	44.06	44.06	40.88	46.26	46.26
Antwerp	do	52.5	47.5	51.09	46.25	41.5	49.69	48.28	43.70	47.61	45.56
Hamburg	do	52.00	46.00	50.00	44.00	39.00	47.00	46.00	45.75	49.00	46.00
Amsterdam	do	52.5	47.00	51.00	45.00	40.00	42.00	42.00	45.42	46.00	45.00
Rotterdam	do	52.5	47.00	51.00	45.00	40.00	42.00	42.00	44.53	46.00	45.00
Copenhagen	do	58.13	51.72	55.31	47.75	42.00	49.69	46.88	48.66	51.00	51.00
Stockholm	do	69.25	62.97	64.5	53.25	45.00	52.5	49.69	51.47	53.50	53.00
Stettin	do	58.13	51.72	55.31	47.75	42.00	49.69	46.88	48.18	50.00	49.00
Bordeaux	do	65.75	59.12	64.12	54.25	51.25	56.25	56.25	51.45	53.00	55.00

Cost of hauling specified products from farms to shipping points in the United States during the crop year 1907–1908.

Product.	Pounds hauled.	Farm value of loads.	Cost of hauling.		
			Per 100 pounds.	Total.	Per cent of farm value of loads.
Barley	[a] 6,599,000,000	$91,726,000	$0.07	$4,619,000	5.0
Corn	[b] 26,131,000,000	240,642,000	.07	18,292,000	7.6
Cotton	5,302,949,000	551,507,000	.16	8,485,000	1.6
Flaxseed	[a] 1,207,000,000	20,640,000	.08	966,000	4.7
Hemp	[c] 12,000,000	546,000	.06	7,000	1.3
Hops	48,330,000	4,785,000	.11	53,000	1.1
Oats	[b] 6,760,000,000	93,679,000	.07	4,732,000	5.1
Peanuts	[c] 263,000,000	7,271,000	.12	316,000	4.3
Rice	[a] 803,000,000	15,337,000	.11	883,000	5.8
Tobacco	698,126,000	76,234,000	.10	698,000	.9
Wheat	[b] 22,066,000,000	321,573,000	.09	19,859,000	6.2
Wool	130,359,000	26,500,000	.44	574,000	2.1
Total	70,020,764,000	$1,450,440,000	.08	59,484,000	4.1

[a] Crop of 1907, less an estimated quantity kept for seed.
[b] Quantity shipped out of county where grown.
[c] Crop of 1899, Census figures.

Average cost of hauling products from farms to shipping points in the United States, 1906.[a]

Product hauled.	Number of counties reporting.	Average—					
		Miles to shipping point.	Days for round trip.	Pounds in one load.	Cost per load.	Cost per 100 pounds.	Cost per ton per mile.
Apples	114	9.6	0.9	2,300	$2.79	$0.12	$0.25
Barley	226	8.8	.7	3,970	2.67	.07	.16
Beans	22	9.0	.8	3,172	2.75	.09	.20
Buckwheat	8	8.2	.8	2,438	2.72	.11	.27
Corn	981	7.4	.6	2,696	1.78	.07	.19
Cotton	555	11.8	1.0	1,702	2.76	.16	.27
Cottonseed	110	10.7	.9	1,654	2.42	.15	.28
Flaxseed	51	10.4	.7	3,409	2.70	.08	.15
Fruit (except apples)	99	11.6	1.1	2,181	3.53	.16	.28
Hay	761	8.3	.7	2,786	2.32	.08	.19
Hemp	7	5.2	.7	3,393	2.10	.06	.23
Hogs (live)	316	7.9	.7	[b] 1,941	2.00	[b] .10	[b] .25
Hops	14	11.7	1.0	3,665	3.89	.11	.19
Oats	798	7.3	.6	2,772	1.82	07	.19
Peanuts	19	8.1	.6	1,363	1.67	.12	.30
Potatoes	569	8.2	.7	2,679	2.34	.09	.22
Rice	18	7.5	.8	2,407	2.70	.11	.29
Rye	78	8.4	.7	2,625	2.23	.08	.19
Timothy seed	5	8.0	.8	2,410	1.92	.08	.20
Tobacco	113	9.8	.8	2,248	2.28	.10	.20
Vegetables (except potatoes)	152	9.8	.9	1,852	2.84	.15	.31
Wheat	1,051	9.4	.8	3,323	2.86	.09	.19
Wool	41	39.8	5.6	4,869	21.39	.44	.22

[a] Figures for each product represent the average cost of hauling in only those States in which that product is marketed in considerable quantities.
[b] Average for six States only.

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS.[a]

Agricultural imports of the United States during the five years ending June 30, 1907.

Article imported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle—										
For breeding purposes, number.	1,481	$225,875	684	$79,986	2,314	$93,084	829	$118,368	835	$122,230
Other .... number..	64,694	935,673	15,372	230,751	25,541	365,488	28,190	430,062	31,567	442,892
Total cattle .... do....	66,175	1,161,548	16,056	310,737	27,855	458,572	29,019	548,430	32,402	565,122
Horses—										
For breeding purposes, number.	2,803	1,191,611	2,634	1,090,596	2,853	1,169,011	3,377	1,266,987	3,644	1,574,020
Other .... number..	2,196	344,685	2,092	369,691	2,327	422,072	2,644	449,688	2,436	404,085
Total horses .... do....	4,999	1,536,296	4,726	1,460,287	5,180	1,591,083	6,021	1,716,675	6,080	1,978,105
Sheep—										
For breeding purposes, number.	1,737	38,037	1,253	23,298	2,200	45,319	2,679	53,951	3,081	67,555
Other .... number..	299,886	998,897	236,841	791,991	184,742	659,402	238,068	966,408	221,717	1,052,870
Total sheep .... do....	301,623	1,036,934	238,094	815,289	186,942	704,721	240,747	1,020,359	224,798	1,120,425
All other, including fowls	....	799,067	....	543,296	....	583,078	....	628,958	....	680,630
Total live animals	....	4,533,845	....	3,129,609	....	3,337,454	....	3,914,422	....	4,344,282
Beeswax .... pounds..	488,576	127,220	425,168	116,878	373,569	101,121	587,617	168,014	917,088	264,637
Cochineal .... do....	112,714	24,215	162,362	64,246	84,332	36,876	111,007	53,446	(b)	(b)
Dairy products:										
Butter .... pounds..	207,007	51,564	154,457	34,764	593,104	124,136	196,642	57,955	441,755	117,835
Cheese .... do....	20,671,384	3,183,224	22,707,103	3,284,811	23,095,705	3,379,600	27,286,866	4,303,830	33,848,766	5,704,012
Milk	....	42,696	....	32,931	....	23,014	....	10,858	....	10,188
Total	....	3,277,484	....	3,352,506	....	3,526,750	....	4,372,643	....	5,832,035
Eggs .... dozens..	368,482	29,757	496,825	61,458	352,303	38,541	241,034	21,200	231,859	26,276
Egg yolks	....	25,795	....	22,781	....	37,036	....	10,992	....	10,616
Feathers and downs, crude	....	2,476,659	....	2,742,018	....	2,036,791	....	2,970,260	....	4,401,131

Fibers, animal:										
Silk—										
Cocoons..............pounds..	259	158	29,759	10,697	28,546	7,875	33,592	11,452	71,223	23,807
Raw, or as reeled from the cocoon................pounds..	13,637,206	49,002,597	12,630,883	44,461,564	17,812,133	59,542,892	14,505,324	52,855,611	16,722,207	70,229,518
Waste..................do....	1,633,394	1,008,295	4,062,067	1,628,239	4,516,628	1,489,286	2,813,105	1,213,441	1,950,474	1,158,574
Total silk.............do....	15,270,859	50,011,050	16,722,709	46,100,500	22,357,307	61,040,053	17,352,021	54,080,504	18,743,904	71,411,899
Wool, and hair of the camel, goat, alpaca, and like animals—										
Class 1, clothing......pounds..	42,202,121	7,488,394	45,575,993	8,573,494	109,888,258	24,762,682	86,810,307	20,936,934	82,982,116	21,378,304
Class 2, combing.........do....	15,233,113	2,833,435	12,934,143	2,819,822	26,551,624	6,521,171	15,204,254	4,214,024	10,671,378	3,235,281
Class 3, carpet..........do....	119,702,562	11,831,132	115,232,698	13,420,275	112,695,864	14,941,705	99,674,107	13,917,414	110,194,051	16,920,443
Total wool............do....	177,137,796	22,152,961	173,742,834	24,813,591	249,135,746	46,225,558	201,688,668	39,068,372	203,847,[illegible]45	41,534,028
Total animal fibers....do....	192,408,655	72,164,011	190,465,543	70,914,091	271,493,053	107,265,611	219,040,689	93,148,876	222,591,449	112,945,927
Glue........................pounds..	5,560,616	602,077	5,798,330	598,546	7,439,735	701,847	6,558,168	632,700	6,466,312	596,667
Honey.....................gallons..	287,696	115,400	206,292	69,053	198,617	76,719	138,221	50,651	175,672	70,854
Packing-house products:										
Bladders, other than fish..........		34,019		19,578		15,837		23,915		11,835
Blood, dried..........................				23,671		11,064		24,277		94,023
Bones, hoofs, and horns...........		619,239		536,366		926,505		1,013,351		845,255
Bristles—										
Crude, unsorted......pounds..	34,239	13,069	11,241	10,976	8,122	4,054	13,435	9,389	11,620	5,325
Sorted, bunched, or prepared, pounds......................	3,009,806	2,641,535	2,576,615	2,356,325	2,461,464	2,366,444	2,728,114	2,686,357	3,433,941	3,256,552
Total............pounds..	3,044,045	2,654,604	2,587,856	2,367,301	2,469,586	2,370,498	2,741,549	2,695,746	3,445,561	3,261,877
Grease................................		876,246		1,157,923		1,170,514		1,295,855		1,355,739
Gut....................................		101,827		60,351		62,630		85,587		103,489
Hair...................................		2,702,734		2,639,586		3,328,471		3,704,987		3,038,996
Hide cuttings and other glue stock..		834,421		854,483		1,120,070		1,160,683		1,473,188
Hides and skins, other than furs—										
Cattle hides ....pounds..	131,640,325	16,159,902	85,370,168	10,989,035	113,177,357	14,949,628	156,155,300	21,862,060	134,671,020	20,649,258
Goatskins...............do....	85,114,070	24,928,729	86,338,547	23,971,731	97,803,571	26,945,721	111,079,391	31,773,909	101,201,596	31,715,298
Other...................do....	102,340,303	16,942,982	103,024,752	17,045,304	126,893,934	22,868,797	158,045,419	30,246,198	135,111,199	30,841,989
Total................do....	319,094,698	58,031,613	274,733,467	52,006,070	337,874,862	64,764,146	425,280,110	83,882,167	370,983,815	83,206,545

[a] Forest products come within the scope of the Department of Agriculture and are therefore included in alphabetical order in these tables.
[b] Not separately stated after June 30, 1906.

Agricultural imports of the United States during the five years ending June 30, 1907—Continued.

Article imported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Packing-house products—Continued.										
Meat—										
Sausages, bologna		$111,647		$121,143		$147,119	744,634	$149,593	451,059	$121,205
Other, including meat extracts		719,250		814,341		674,441		675,568		888,209
Total meat		830,897		935,484		821,560		825,161		1,009,414
Oils ... gallons	261,421	50,641	171,544	34,830	175,620	27,559	160,854	23,914	132,843	26,671
Rennets		76,785		94,439		99,481		93,288		117,344
Sausage casings		963,495		885,645		836,323		874,293		1,288,922
Stearin ... pounds	10,481,807	1,097,450	1,492,407	110,606	2,800,540	191,960	1,700,177	134,196	1,184,287	93,385
Other		706,802		30,619		52,223		68,843		48,188
Total packing-house products		69,580,773		61,756,952		75,798,841		95,906,263		95,974,871
Total animal matter		152,957,236		142,828,138		192,957,587		201,249,467		224,467,296
VEGETABLE MATTER.										
Argols, or wine lees ... pounds	29,966,557	2,734,027	24,571,730	2,550,223	26,281,931	2,291,951	28,140,835	2,358,061	30,540,893	2,562,384
Breadstuffs. (*See* Grain and grain products.)										
Broom corn ... tons	3	288	6	392	3	918	1	777	4	1,663
Cider ... gallons	4,871	4,751	5,609	5,941	8,651	8,931	13,644	15,013	8,018	7,842
Cocoa and chocolate:										
Cocoa—										
Crude, and leaves and shells of ... pounds	63,351,294	7,820,087	72,277,600	8,873,709	73,815,895	8,577,649	80,117,402	8,697,515	92,249,819	13,376,562
Prepared, or manufactured, pounds	1,004,766	292,522	1,009,082	300,409	874,878	259,037	1,055,031	299,141	1,267,733	371,816
Total cocoa ... pounds	64,356,060	8,112,609	73,286,682	9,174,118	74,690,773	8,836,686	81,172,433	8,996,656	93,517,552	13,748,378
Chocolate ... do	690,824	144,832	1,784,064	426,486	2,692,251	647,377	2,954,594	702,717	3,541,961	830,611
Total cocoa and chocolate, pounds	65,046,884	8,257,441	75,070,746	9,600,604	77,383,024	9,484,063	84,127,027	9,699,373	97,059,513	14,578,989
Coffee ... pounds	915,086,380	59,200,749	995,043,284	69,551,799	1,047,792,984	84,654,062	851,668,933	73,256,134	985,321,473	78,231,902

Coffee substitutes:										
Chicory root—										
Raw, unground..........do....	1,411,202	27,967	4,138,248	68,312	3,340,913	59,589	3,401,065	58,502	2,597,807	41,680
Roasted, ground, or otherwise prepared...........pounds..	442,311	17,493	534,267	20,175	596,095	22,395	546,809	20,560	615,267	25,770
Total chicory root...do....	1,853,513	45,460	4,672,515	88,487	3,937,008	81,984	3,947,874	79,062	3,213,074	67,450
Other....................do....	450,643	23,613	462,378	26,483	244,327	15,407	439,227	28,705	341,486	23,385
Total coffee substitutes....do....	2,304,156	69,073	5,134,893	114,970	4,181,335	97,391	4,387,101	107,767	3,554,560	90,835
Curry and curry powder..............	....	9,112	....	9,955	....	8,327	....	10,424	....	14,983
Fibers, vegetable:										
Cotton....................pounds..	74,874,426	10,892,591	48,840,590	8,541,510	60,508,548	9,414,750	70,963,633	10,879,592	104,791,784	19,930,988
Flax.......................tons..	8,155	2,028,012	10,123	2,541,874	8,089	2,260,421	8,729	2,327,300	8,656	2,254,112
Hemp.......................do....	4,919	821,261	5,871	869,260	3,987	638,325	5,317	906,808	8,718	1,534,371
Istle, or Tampico fiber.......do....	14,670	1,086,682	13,622	1,199,014	15,607	1,405,184	13,914	1,283,311	14,966	1,369,206
Jute and jute butts..........do....	79,703	3,358,825	96,735	4,104,870	98,215	4,500,023	103,945	6,449,684	104,489	8,950,918
Manila hemp.................do....	61,648	11,885,510	65,666	11,423,395	61,562	12,065,270	58,738	11,036,667	54,513	10,876,107
Sisal grass..................do....	87,025	13,289,444	109,214	15,935,555	100,301	15,256,859	98,037	15,282,208	99,061	14,959,415
Other.......................do....	16,075	1,992,779	14,428	1,740,317	17,149	1,991,989	18,603	2,074,312	22,580	2,295,229
Total..........................	....	45,355,104	....	46,355,795	....	47,532,821	....	50,239,882	....	62,170,346
Flowers, natural....................	....	31,577	....	42,612	....	29,080	....	27,275	....	32,729
Forest products:										
Charcoal..........................	....	....	231,302	14,844	5,643	478	774,501	42,856	144,802	8,516
Cinchona bark............pounds..	3,978,850	549,753	3,605,131	501,375	4,251,869	570,725	4,076,553	383,726	3,515,958	380,552
Cork wood or cork bark..............	....	1,737,366	....	1,484,405	....	1,729,143	....	1,837,134	....	2,356,052
Dyewoods, and extracts of—										
Dyewoods—										
Logwood............tons..	51,008	748,550	48,491	663,572	35,514	444,824	37,313	496,551	38,230	478,636
Other........................	....	401,849	....	588,934	....	77,751	....	109,515	....	54,906
Total dyewoods..........	....	1,150,399	....	1,252,506	....	522,575	....	606,066	....	533,538
Extracts and decoctions of, pounds....................	3,723,133	267,371	3,145,770	269,777	3,436,642	299,036	3,390,316	290,179	4,796,655	379,927
Total dyewoods and extracts of................	....	1,417,770	....	1,522,283	....	821,611	....	896,245	....	913,465
Gums, not elsewhere specified—										
Arabic................pounds..	3,905,053	265,386	2,890,051	186,623	3,651,544	190,132	4,055,233	232,715	7,068,066	393,581
Camphor, crude..........do....	2,472,440	764,403	2,819,673	874,665	1,904,002	638,744	1,668,744	608,440	3,138,070	1,572,863
Chicle..................do....	4,282,247	954,389	5,084,580	1,308,540	5,060,166	1,357,458	5,641,508	1,495,366	6,732,581	2,139,204
Copal, cowrie, and dammar, pounds......................	27,653,928	2,938,754	20,565,507	2,127,228	25,687,762	2,493,438	20,448,703	1,914,663	26,681,736	2,835,332

Agricultural imports of the United States during the five years ending June 30, 1907—Continued.

Article imported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Forest products—Continued.										
Gums, not elsewhere specified—										
Gambier, or terra japonica, pounds	42,537,348	$2,034,511	27,857,055	$1,251,782	32,192,731	$1,112,660	31,278,485	$1,118,910	28,865,617	$977,009
Shellac ... pounds	11,590,725	2,713,687	10,933,413	3,505,229	10,700,817	3,743,180	15,780,090	5,107,542	17,785,960	5,821,688
Other	...	923,517	...	917,815	...	1,094,869	...	1,423,088	...	1,234,479
Total	...	10,594,647	...	10,171,882	...	10,630,481	...	11,900,724	...	14,974,156
India rubber, gutta-percha, etc.—										
Balata ... pounds	(a)	(a)	(a)	(a)	(a)	(a)	374,220	152,689	799,201	305,041
Guayule ... do	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	1,187,596	24,613
Gutta-joolatong, or East Indian gum ... pounds	13,984,817	345,431	14,887,416	430,231	19,104,911	641,319	21,390,116	733,074	28,437,660	1,085,098
Gutta-percha ... do	316,290	222,400	424,617	174,953	665,217	210,188	500,770	188,161	546,890	201,339
India rubber ... do	55,010,571	30,436,710	59,015,551	40,444,250	67,234,256	49,878,366	57,844,345	45,114,450	76,963,838	58,919,981
Total ... do	69,311,678	31,004,541	74,327,584	41,049,434	87,004,384	50,729,873	80,109,451	46,188,374	107,935,185	60,536,072
Ivory, vegetable ... do	17,194,434	192,093	15,740,792	229,944	19,688,913	410,883	21,076,508	516,607	16,602,229	464,931
Naval stores—										
Tar and pitch (of wood), barrels	1,242	6,004	1,063	6,643	574	3,206	1,363	6,504	1,330	6,928
Turpentine, spirits of, gallons	16,705	6,020	19,751	6,224	43,063	13,546	158,730	59,273	35,386	16,110
Total	...	12,024	...	12,867	...	16,752	...	65,777	...	23,038
Palm leaf, natural	...	5,339	...	5,610	...	9,434	...	8,114	...	14,779
Sumac, ground ... pounds	12,858,547	187,186	18,604,644	276,891	15,583,334	225,036	15,131,539	237,309	12,487,103	267,239
Tanning materials:										
Hemlock bark ... cords	17,040	75,283	14,111	63,460	13,511	64,181	7,467	35,860	6,744	30,757
Mangrove bark ... tons	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	20,693	426,431
Quebracho, extract of ... pounds	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	79,033,584	2,319,785
Quebracho, wood ... tons	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	66,810	840,779
Other	...	56,401	...	194,201	...	923,949	...	1,419,962	...	84,406
Total	...	131,684	...	257,661	...	988,130	...	1,455,822	...	3,702,158

Wood, not elsewhere specified—										
Cabinet woods, unsawed—										
Mahogany..........M feet..	48,387	2,783,679	50,370	2,690,382	31,844	1,977,894	36,619	2,470,072	51,899	3,263,718
Other..........	....	1,251,621	....	1,434,229	....	1,077,723	....	1,334,748	....	2,091,882
Total cabinet woods......	....	4,035,300	....	4,124,611	....	3,055,617	....	3,804,820	....	5,355,600
Timber—										
Round, including logs, M feet..........	73,836	637,881	66,033	552,504	97,306	722,693	100,592	773,260	97,573	938,501
Hewn, squared, or sided, cubic feet..........	207,554	41,131	139,180	33,357	184,742	28,912	256,180	46,770	....	....
Pulp wood..........	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	650,366	2,792,751
Total timber..........	....	679 012	....	585,861	....	751,605	....	820,030	....	3,731,252
Lumber—										
Boards, deals, planks, and other sawed lumber, M feet..........	720,937	10,673,317	589,232	8,878,474	710,538	10,906,661	949,717	14,813,733	934,195	16,255,350
Shingles..........M..	724,131	1,494,906	770,373	1,602,999	758,725	1,581,421	900,856	1,852,612	881,003	1,940,001
Other..........	....	1,753,532	....	1,545,384	....	1,649,314	....	2,700,505	....	2,764,015
Total lumber..........	....	13,921,755	....	12,026,857	....	14,137,396	....	19,366,850	....	20,959,366
All other..........	....	3,621,782	....	3,752,103	....	4,102,436	....	4,353,034	....	2,384,743
Total wood, n. e. s..........	....	22,257,849	....	20,489,432	....	22,047,054	....	28,344,734	....	32,430,961
Wood pulp..........tons..	116,881	3,387,770	144,796	3,602,668	167,504	4,500,955	157,224	4,584,942	213,110	6,348,857
Total forest products..........	....	71,478,022	....	79,619,296	....	92,680,555	....	96,462,364	....	122,420,776
Fruit juices, n. e. s.:										
Prune juice, or prune wine..gallons..	53,135	40,435	70,521	38,227	52,765	37,118	50,237	34,900	52,940	35,068
Other, including cherry juice..do....	32,810	16,709	62,988	27,731	23,574	14,130	40,893	24,661	54,553	35,662
Total..........do..	85,945	57,144	133,509	65,958	76,339	51,248	91,130	59,561	107,493	70,730
Fruits:										
Fresh or dried—										
Bananas..........	....	8,541,156	....	7,709,976	....	9,897,821	....	10,330,302	....	11,883,168
Currants..........pounds..	33,878,209	743,644	38,347,649	997,430	31,742,919	764,289	37,078,311	1,119,146	38,392,779	1,746,941
Dates..........do....	21,681,159	486,151	21,058,164	463,459	19,257,250	360,483	22,435,672	479,142	31,270,899	850,558
Figs..........do....	16,482,142	775,917	13,178,061	660,360	13,364,107	617,027	17,562,358	722,967	24,346,173	1,136,924
Grapes..........cubic feet..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	1,298,469	1,575,521
Lemons..........pounds..	152,004,213	3,079,221	171,923,221	3,659,598	139,084,321	2,905,082	138,717,252	2,933,990	157,859,906	4,253,296
Olives..........gallons..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	2,298,480	1,277,973
Oranges..........pounds..	56,872,070	818,780	35,893,260	525,468	28,880,575	374,088	31,134,341	456,726	21,267,346	354,495

[a] Not separately stated.

Agricultural imports of the United States during the five years ending June 30, 1907—Continued.

Article imported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Fruits—Continued.										
Fresh or dried—										
Plums and prunes....pounds..	633,819	$63,218	494,105	$46,976	671,604	$63,617	497,494	$53,348	323,377	$45,386
Raisins....do....	6,715,675	476,844	6,867,617	355,542	4,041,689	273,031	12,414,855	524,590	3,967,151	364,403
Other....	....	2,353,864	....	2,749,670	....	2,924,187	....	2,484,345	....	1,363,167
Total fresh or dried....	....	17,338,795	....	17,168,479	....	18,179,625	....	19,104,556	....	24,851,832
Prepared or preserved....	....	1,521,443	....	1,796,209	....	1,599,488	....	2,437,766	....	1,272,445
Total fruits....	....	18,860,238	....	18,964,688	....	19,779,113	....	21,542,322	....	26,124,277
Ginger, preserved or pickled..pounds..	569,292	23,810	230,890	13,502	436,051	24,874	365,255	19,516	472,190	29,810
Grain and grain products:										
Grain—										
Barley....bushels..	56,462	30,201	90,708	45,245	81,020	39,546	18,049	9,803	38,319	14,033
Corn....do....	40,919	29,966	16,633	10,837	15,443	10,623	10,127	8,458	10,818	8,337
Oats....do....	137,416	45,899	170,882	57,802	38,773	18,626	22,675	10,726	74,552	26,634
Rye....do....	838	430	32,512	20,329	20,551	13,576	5	4	158	126
Wheat....do....	1,077,424	669,419	6,852	7,517	3,102,585	2,769,317	57,995	53,291	375,433	237,049
Total grain....do....	1,313,059	775,915	317,587	141,730	3,258,372	2,851,688	108,851	82,282	499,280	286,179
Grain products—										
Macaroni, vermicelli, etc. pounds..	28,787,821	1,171,887	40,224,202	1,617,634	53,441,080	2,083,833	77,926,029	2,941,204	87,720,730	3,479,824
Malt....bushels..	2,468	3,029	3,465	3,250	3,298	3,580	2,458	2,711	3,362	3,917
Meal and flour—										
Oatmeal....pounds..	227,681	13,685	235,819	14,201	304,668	16,361	312,306	16,625	301,266	15,581
Wheat flour....barrels..	601	4,489	46,851	164,100	40,801	176,513	45,314	177,239	47,702	159,046
Total meal and flour....	....	18,174	....	178,301	....	192,874	....	193,864	....	174,627
Other....	....	438,963	....	613,916	....	667,427	....	465,838	....	520,256
Total grain products....	....	1,632,053	....	2,413,101	....	2,947,714	....	3,603,617	....	4,178,624
Total grain and grain products....	....	2,407,968	....	2,554,831	....	5,799,402	....	3,685,899	....	4,464,803

Hay..........tons..	293,112	2,238,109	114,388	914,842	46,214	359,515	68,540	502,051	61,116	501,507
Hops..........pounds..	6,012,510	1,808,491	2,758,163	1,374,327	4,339,379	1,980,804	10,113,989	2,326,982	6,211,893	1,974,900
Indigo..........do....	4,532,458	1,202,451	5,046,614	1,282,497	4,830,930	873,781	7,392,853	1,044,148	7,170,057	1,233,541
Licorice root..........do....	88,580,611	1,545,167	89,463,182	1,472,323	108,443,893	1,780,109	102,151,969	1,661,454	66,115,863	1,140,541
Liquors, alcoholic:										
Distilled spirits—										
Of domestic manufacture, returned........proof gallons..	819,591	846,404	471,596	539,362	316,469	326,885	177,499	211,129	154,106	162,072
Brandy..........do....	348,878	1,000,997	390,988	1,104,410	403,386	1,139,129	470,433	1,286,270	629,333	1,687,473
Other..........do....	2,061,057	2,987,179	2,238,842	3,313,735	2,366,466	3,539,044	2,639,680	4,027,368	3,270,226	5,037,146
Total distilled spirits, proof gallons..........	3,229,526	4,834,580	3,101,426	4,957,507	3,086,321	5,005,058	3,287,612	5,524,767	4,053,665	6,886,691
Malt liquors—										
Unbottled..........gallons..	2,966,343	835,694	3,197,955	927,507	3,836,487	1,119,768	4,395,032	1,272,627	5,165,929	1,506,108
Bottled..........do....	1,292,475	1,252,047	1,467,756	1,385,818	1,362,089	1,285,576	1,582,619	1,466,228	2,041,688	1,902,655
Total malt liquors.....do....	4,258,818	2,087,741	4,665,711	2,313,325	5,198,576	2,405,344	5,977,651	2,738,855	7,207,617	3,408,763
Wines—										
Champagne and other sparkling..........dozen quarts..	407,944	5,861,639	336,245	4,969,635	371,811	5,723,764	415,394	6,127,062	419,403	6,228,281
Still wines—										
Unbottled........gallons..	3,753,211	2,292,297	4,007,691	2,387,018	3,973,919	2,352,485	4,482,499	2,567,712	5,213,458	2,966,154
Bottled.....dozen quarts..	440,869	2,095,360	471,153	2,035,217	488,773	2,165,672	546,688	2,299,194	636,938	2,614,346
Total still wines..........	....	4,387,657	....	4,422,235	....	4,518,157	....	4,866,906	....	5,580,500
Total wines..........	....	10,249,296	....	9,391,870	....	10,241,921	....	10,993,968	....	11,808,781
Total alcoholic liquors..........	....	17,171,617	....	16,662,702	....	17,652,323	....	19,257,590	....	22,104,235
Malt, barley. (*See* Grain and grain products.)										
Malt extract, fluid or solid..........	....	3,008	....	2,924	....	5,128	....	2,473	....	3,163
Malt liquors. (*See* Liquors, alcoholic.)										
Meal, cottonseed..........pounds..	....	....	....	....	....	....	661,505	4,991	....	....
Nursery stock:										
Plants, trees, shrubs, vines, etc....	....	1,371,588	....	1,493,789	....	1,510,435	....	1,599,052	....	1,841,206
Subtropical plants, etc., for propagation..........	....	1,610	....	2,638	....	1,631	....	18,570	....	11,328
Total nursery stock..........	....	1,373,198	....	1,496,427	....	1,512,066	....	1,617,622	....	1,852,534

Agricultural imports of the United States during the five years ending June 30, 1907—Continued.

Article imported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Nuts:										
Almonds..........pounds..	8,142,164	$1,337,717	9,838,852	$1,246,474	11,745,081	$1,520,063	15,009,326	$1,825,475	14,233,613	$2,331,816
Cocoanuts..........		908,242		971,852		1,086,473		1,298,740		1,349,562
Cocoanut meat, broken, or copra, pounds..........	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	7,064,532	302,132
Cream and Brazil.........bushels..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	252,538	650,488
Palm, and palm nut kernels..........		(a)		(a)		(a)		(a)		38,962
Walnuts..........pounds..	12,362,567	1,106,033	23,670,761	1,729,378	21,864,104	1,469,463	24,917,028	2,193,653	32,597,592	2,969,649
Other..........		1,514,406		1,523,462		2,082,344		2,055,557		2,100,274
Total nuts..........		4,866,398		5,471,166		6,158,343		7,373,425		9,742,883
Oil cake..........pounds..	3,827,014	30,286	1,794,873	18,592	1,129,013	12,968	5,454,941	54,144	512,654	5,342
Oils, vegetable:										
Fixed or expressed—										
Cocoanut oil..........pounds..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	35,544,356	2,623,974
Nut oil, or oil of nuts, n. e. s. gallons..........	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	2,453,597	1,040,722
Olive, for mechanical purposes, gallons..........	(a)	(a)	(a)	(a)	(a)	(a)	2,538,366	1,105,876	1,471,766	682,656
Olive, salad..........gallons..	1,494,132	1,736,648	1,713,590	1,875,825	1,923,174	2,108,893	2,447,131	2,566,994	3,449,517	3,523,725
Palm oil..........pounds..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	29,656,207	1,893,285
Other..........		7,750,712		5,952,702		6,010,432		6,015,403		1,925,300
Total fixed or expressed..........		9,487,360		7,828,527		8,119,325		9,688,273		11,689,662
Volatile, or essential..........		2,156,331		2,396,748		2,534,723		2,863,005		3,702,220
Total vegetable oils..........		11,643,691		10,225,275		10,654,048		12,551,278		15,391,882
Olive nuts, ground..........								6,899		
Opium, crude..........pounds..	516,570	1,019,909	573,055	1,255,115	594,680	1,162,461	469,387	1,143,683	565,252	1,482,649
Rice, rice meal, etc.:										
Rice..........do....	78,317,310	1,732,238	75,323,157	1,869,338	43,408,509	1,097,099	58,468,791	1,465,487	71,287,151	2,118,147
Rice flour, rice meal, and broken rice..........pounds..	91,338,974	1,329,235	78,898,615	1,204,092	63,075,006	913,867	108,079,166	1,616,716	138,316,029	2,273,999
Total..........do....	169,656,284	3,061,473	154,221,772	3,073,430	106,483,515	2,010,966	166,547,957	3,082,203	209,603,180	4,392,146

Sago, tapioca, etc	....	618,221	....	695,922	....	761,525	....	830,479	....	1,432,082
Seeds:										
Clover .... bushels..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	22,849,115	2,385,734
Flaxseed, or linseed .... do...	129,089	194,024	213,270	201,224	296,184	318,687	52,240	73,423	90,356	124,494
Other	....	2,637,255	....	3,386,245	....	3,138,932	....	5,314,620	....	3,894,548
Total	....	2,831,279	....	3,587,469	....	3,457,619	....	5,388,043	....	6,404,776
Spices:										
Unground—										
Nutmegs .... pounds..	2,365,624	444,643	1,498,600	288,388	2,394,061	347,721	2,626,005	342,378	2,375,139	321,719
Pepper, black or white, pounds	21,832,675	2,296,221	18,615,186	2,069,051	19,413,387	1,969,521	26,535,834	2,733,137	24,320,865	2,232,774
Other .... pounds..	22,464,192	1,590,778	17,745,806	1,469,587	26,115,130	1,731,895	20,037,435	1,429,008	20,374,842	1,838,512
Total unground .... do...	46,662,491	4,331,642	37,859,592	3,827,026	47,922,578	4,049,137	49,199,274	4,504,523	47,070,846	4,393,005
Ground .... do...	4,538,688	483,483	5,414,804	538,982	5,106,179	534,219	7,047,685	683,593	6,490,048	719,995
Total spices .... do...	51,201,179	4,815,125	43,274,396	4,366,008	53,028,757	4,583,356	56,246,959	5,188,116	53,560,894	5,113,000
Spirits distilled. (*See* Liquors, alcoholic.)										
Starch .... pounds..	10,540,905	205,949	7,430,383	191,450	6,140,753	180,465	5,422,267	156,176	6,330,493	152,020
Straw .... tons..	3,303	12,832	10,838	81,794	2,825	12,700	4,317	16,539	1,497	6,147
Sugar and molasses:										
Molasses .... gallons..	17,240,399	1,124,710	18,828,530	1,018,198	19,477,885	1,137,844	16,021,076	690,718	24,630,935	919,806
Sugar—										
Raw—										
Beet .... pounds..	87,130,805	1,223,023	2,414,454	50,525	223,944,976	4,797,278	48,548,919	1,032,040	397,745,046	8,203,309
Cane .... do...	4,075,635,121	69,740,051	3,681,904,214	71,359,114	3,434,186,471	91,943,398	3,921,605,729	84,066,863	3,986,510,021	84,273,071
Total raw .... do...	4,162,765,926	70,963,074	3,684,318,668	71,409,639	3,658,131,447	96,740,676	3,970,154,648	85,098,903	4,384,255,067	92,476,380
Refined .... do...	53,342,180	1,125,899	16,304,945	506,114	22,801,551	904,773	9,176,782	361,185	7,584,908	329,873
Total sugar .... do...	4,216,108,106	72,088,973	3,700,623,613	71,915,753	3,680,932,998	97,645,449	3,979,331,430	85,460,088	4,391,839,975	92,806,253
Total sugar and molasses	....	73,213,683	....	72,933,951	....	98,783,293	....	86,150,806	....	93,726,059
Tea .... pounds..	108,574,905	15,659,229	112,905,541	18,229,310	102,706,599	16,230,858	93,621,750	14,580,878	86,368,490	13,915,544
Teasels	....	....	....	....	....	....	....	10,169	....	9,756

a Not separately stated.

Agricultural imports of the United States during the five years ending June 30, 1907—Continued.

Article imported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Tobacco:										
Wrapper....pounds..	6,314,359	$4,669,932	7,387,390	$5,641,124	7,109,595	$5,270,032	6,732,774	$6,475,226	7,576,325	$8,617,575
Filler and other leaf....do....	27,702,597	12,564,983	23,775,246	11,298,363	26,178,783	12,768,645	30,622,703	15,972,288	31,963,996	17,437,673
Stems....do....	(a)	(a)	(a)	(a)	(a)	(a)	3,770,493	15,954	1,358,486	4,737
Total....do....	34,016,956	17,234,915	31,162,636	16,939,487	33,288,378	18,038,677	41,125,970	22,463,468	40,898,807	26,059,985
Vanilla beans....pounds..	521,689	1,032,654	550,328	1,424,647	608,116	871,442	852,505	1,321,550	969,249	1,523,156
Vegetables:										
Fresh or dried—										
Beans and dried pease, bushels..	1,088,665	1,420,334	978,187	1,223,309	472,572	628,775	458,041	667,214	406,679	656,898
Onions....do....	925,599	699,657	1,171,242	914,413	856,366	643,207	872,566	615,584	1,126,114	926,115
Potatoes....do....	358,505	238,445	3,166,581	1,870,004	181,199	168,094	1,948,160	853,063	176,917	192,635
Other....	....	497,666	....	780,761	....	646,736	....	815,068	....	1,024,262
Total fresh or dried....	....	2,856,102	....	4,788,487	....	2,086,812	....	2,950,929	....	2,799,910
Vegetables:										
Prepared or preserved—										
Pickles and sauces....	....	537,356	....	646,858	....	578,489	....	706,050	....	934,803
Other....	....	1,187,897	....	1,573,257	....	1,317,971	....	1,435,953	....	1,993,759
Total prepared or preserved..	....	1,725,253	....	2,220,115	....	1,896,460	....	2,142,003	....	2,928,562
Total vegetables....	....	4,581,355	....	7,008,602	....	3,983,272	....	5,092,932	....	5,728,472
Vinegar....gallons..	152,524	42,656	181,294	46,856	191,768	46,434	198,591	49,319	230,072	65,282
Wafers, unmedicated....	....	19,111	....	20,327	....	19,293	....	26,353	....	26,617
Wines. (*See* Liquors, alcoholic.)										
Total vegetable matter, including forest products....	....	374,720,111	....	398,226,009	....	453,574,182	....	449,388,139	....	524,790,288
Total vegetable matter, excluding forest products....	....	303,242,089	....	318,606,713	....	360,893,627	....	352,925,775	....	402,369,512
Total agricultural imports, including forest products....	....	527,677,347	....	541,054,147	....	646,531,769	....	650,637,606	....	749,257,584
Total agricultural imports, excluding forest products....	....	456,199,325	....	461,434,851	....	553,851,214	....	554,175,242	....	626,836,808

a Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1907.

Article exported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle.....number..	402,178	$29,848,936	593,409	$42,256,291	567,806	$40,598,048	584,239	$42,081,170	423,051	$34,577,392
Hogs.....do....	4,031	40,923	6,345	53,780	44,496	416,692	59,170	630,998	24,262	309,440
Horses.....do....	34,007	3,152,159	42,001	3,189,100	34,822	3,175,259	40,087	4,365,981	33,882	4,359,957
Mules.....do....	4,294	521,725	3,658	412,971	5,826	645,464	7,167	989,639	6,781	850,901
Sheep.....do....	176,961	1,067,860	301,313	1,954,604	268,365	1,687,321	142,690	804,090	135,344	750,242
Other, including fowls.....		149,590		111,129		205,497		267,690		355,148
Total.....		34,781,193		47,977,875		46,728,281		49,139,568		41,203,080
Beeswax.....pounds..	70,811	21,337	55,631	16,545	85,406	24,966	101,726	29,894	117,169	36,392
Dairy products:										
Butter.....do....	8,896,166	1,604,327	10,717,824	1,768,184	10,071,487	1,648,281	27,360,537	4,922,913	12,544,777	2,429,489
Cheese.....do....	18,987,178	2,250,229	23,335,172	2,452,239	10,134,424	1,084,044	16,562,451	1,940,620	17,285,230	2,012,626
Milk.....		921,026		1,367,794		2,156,616		1,889,690		2,191,111
Total.....		4,775,582		5,588,217		4,888,941		8,753,223		6,633,226
Eggs.....dozens..	1,517,189	325,571	1,776,632	396,408	2,475,884	543,386	4,952,063	1,038,649	6,968,985	1,542,789
Egg yolks.....		48,108		28,294		917		54,851		11,565
Feathers.....		141,257		157,035		239,256		263,377		316,306
Fibers, animal:										
Silk waste.....pounds..	149,400	19,968	227,139	30,814	72,451	9,806	71,368	13,781	129,078	37,709
Wool.....do....	518,919	71,818	319,750	37,171	123,951	15,068	192,481	29,095	214,840	48,820
Total.....do....	668,319	91,786	546,889	67,985	196,402	24,874	263,849	42,876	343,918	86,529
Glue.....do....	2,569,164	253,768	2,656,057	258,511	2,824,202	279,534	3,157,837	298,796	3,481,715	331,998
Honey.....		64,220		69,317		63,367		111,945		93,690
Packing-house products:										
Bones, hoofs, horns, and horn tips, strips, and waste.....		193,817		208,523		181,203		212,516		172,208
Bristles.....		515		1,808		1,497		329		2,732
Grease, grease scraps, and all soap stock.....		2,926,565		3,311,777		3,710,907		4,138,333		5,473,623
Hair.....		616,133		724,514		778,471		854,038		938,433
Hides and skins, other than furs, pounds.....	12,859,549	1,224,409	32,727,643	3,246,887	10,268,722	1,051,641	10,752,827	1,223,255	15,396,806	1,760,032
Lard.....pounds..	490,755,821	50,854,504	561,302,643	46,347,520	610,238,899	47,243,181	741,516,886	60,132,091	627,559,660	57,497,980
Lard compounds.....do....	46,130,004	3,607,542	53,603,545	3,581,813	61,215,187	3,613,235	67,621,310	4,154,183	80,148,861	6,166,910

Agricultural exports (domestic) of the United States during the five years ending June 30, 1907—Continued.

Article exported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Packing-house products—Continued.										
Meat—										
Beef—										
Fresh .... pounds..	254,795,963	$25,013,323	299,579,671	$26,841,586	236,486,568	$22,138,365	268,054,227	$24,310,038	281,651,502	$26,367,287
Cured—										
Salted or pickled.do....	52,801,220	3,814,671	57,584,710	3,260,475	55,934,705	3,095,304	81,088,098	4,697,742	62,645,281	3,740,212
Other ....do....	1,126,032	102,184	269,112	20,542	136,476	14,057	199,483	22,063	1,053,287	107,956
Total cured...do....	53,927,252	3,916,855	57,853,822	3,281,017	56,071,181	3,109,361	81,287,581	4,719,805	63,698,568	3,848,168
Canned............do....	76,307,114	7,916,928	57,468,338	5,882,888	66,688,568	6,588,958	64,523,359	6,430,446	15,809,826	1,615,808
Total beef........do....	385,030,329	36,847,106	414,901,831	36,005,491	359,246,317	31,836,684	413,865,167	35,460,289	361,159,896	31,831,263
Canned meat, n. e. s........	....	1,831,940	....	2,254,235	....	1,974,693	....	1,593,497	....	745,247
Mutton.............pounds..	6,144,020	532,476	465,255	40,618	640,837	52,503	516,345	51,163	822,998	83,874
Pork—										
Fresh.............do....	20,966,113	2,035,491	18,633,820	1,669,818	14,946,284	1,291,794	13,444,438	1,261,412	11,467,779	1,143,886
Cured—										
Bacon..........do....	207,336,000	22,178,525	249,665,941	24,446,752	262,246,635	25,428,961	361,210,563	35,845,793	250,418,699	26,470,972
Hams..........do....	214,183,365	25,712,633	194,948,864	22,293,867	203,458,724	21,562,204	194,267,949	20,075,511	209,481,496	23,698,207
Salted or pickled.do....	95,287,374	9,959,762	112,224,861	9,527,388	118,887,189	9,412,034	141,820,720	11,681,634	166,427,409	15,167,058
Total cured...do....	516,806,739	57,850,920	556,839,666	56,268,007	584,592,548	56,403,199	697,299,232	67,602,938	626,327,604	65,336,237
Canned............do....	13,590,897	1,369,687	9,479,312	963,321	10,254,239	993,394	12,699,800	1,215,857	2,710,369	287,460
Total pork........do....	551,363,749	61,256,098	584,952,798	58,901,146	609,793,071	58,688,387	723,443,470	70,080,207	640,505,752	66,767,583
Sausage and sausage meat, pounds...............	5,264,648	585,088	5,562,349	602,528	6,061,508	671,241	7,926,786	881,686	8,000,973	925,877
Total meat............	....	101,052,708	....	97,804,018	....	93,223,508	....	108,066,842	....	100,353,844
Oils—										
Lard oil.............gallons..	356,658	306,334	376,826	244,499	260,797	154,409	298,103	180,474	234,730	144,063
Oleo oil ....pounds..	126,010,339	11,981,888	165,183,839	12,873,558	145,228,245	11,485,145	209,658,075	17,455,976	195,337,176	16,819,933
Other................gallons..	221,669	159,505	452,481	273,481	377,777	217,596	338,687	224,991	503,234	292,381

Total oils		12,447,727		13,391,538		11,857,150		17,861,441		17,256,377
Oleomargarin (imitation butter), pounds	7,645,652	798,273	6,137,251	605,874	7,863,164	711,038	11,794,174	1,033,256	5,397,609	520,406
Sausage casings		1,964,524		2,353,167		2,646,868		2,572,479		3,422,271
Tallow, pounds	27,368,924	1,623,852	76,924,174	3,801,302	63,536,992	3,022,173	97,567,156	4,791,025	127,857,739	7,182,688
Other		2,101,785		2,062,813		2,267,359		2,633,986		2,708,632
Total packing-house products		179,412,354		177,441,554		170,308,231		207,673,774		203,456,136
Poultry and game		1,079,056		1,009,304		897,425		1,397,004		1,086,618
Quills		3,976		23,164		1,618		150		
Silk waste. (*See* Fibers, animal.)										
Wool. (*See* Fibers, animal.)										
Total animal matter		220,998,208		233,034,209		224,000,796		268,804,107		254,798,329
VEGETABLE MATTER.										
Breadstuffs. (*See* Grain and grain products.)										
Broom corn		211,253		226,179		227,066		240,164		268,812
Cider, gallons	598,119	84,084	714,476	103,314	394,723	61,204	344,117	53,577	197,514	30,681
Cocoa, ground or prepared, and chocolate		213,476		250,084		279,819		349,107		376,467
Coffee:										
Green or raw, pounds	29,233,837	3,295,968	32,208,497	3,656,943	15,559,235	1,966,107	28,346,323	3,483,238	38,771,906	4,692,137
Roasted or prepared, do	535,108	89,899	405,893	64,516	550,016	82,451	838,181	117,749	2,261,517	297,280
Total, do	29,768,945	3,385,867	32,614,390	3,721,459	16,109,251	2,048,558	29,184,504	3,600,987	41,033,423	4,989,417
Cotton:										
Sea Island, bales	51,688	4,038,370	34,776	3,154,376	42,721	3,365,448	42,271	3,335,022	20,173	2,075,446
Sea Island, pounds	20,205,080		13,254,404		16,653,124		16,245,924		7,605,804	
Upland, bales	6,886,591	312,142,059	5,974,418	367,656,870	8,295,243	376,599,566	[a] 7,008,085	[a] 397,670,899	[a] 8,688,296	[a] 479,202,351
Upland, pounds	3,522,837,942		3,049,938,356		4,288,195,779		[a] 3,617,799,246		[a] 4,510,611,416	
Linters, pounds	26,098,947	884,842	26,663,146	1,238,018	34,473,174	1,433,925	([b])	([b])	([b])	([b])
Total, do	3,569,141,969	317,065,271	3,089,855,906	372,049,264	4,339,322,077	381,398,939	3,634,045,170	401,005,921	4,518,217,220	481,277,797
Flavoring extracts and fruit juices								52,490		48,491
Flowers, cut		5,290		5,076		4,522		3,496		2,579
Forest products:										
Bark, and extract of, for tanning—										
Bark, pounds	([c])	([c])	([c])	([c])	([c])	([c])	4,873,237	75,084	2,322,130	29,975
Bark, extracts of		([c])		([c])		([c])		356,847		305,998
Total		239,786		291,783		552,909		431,931		335,973

[a] Including linters. [b] Included in upland. [c] Not separately stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1907—Continued.

Article exported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Forest products—Continued.										
Charcoal	....	$5,118	....	$22,646	....	$23,479	....	$14,727	....	$7,956
Moss	....	....	....	....	....	....	....	37,201	....	40,578
Naval stores—										
Rosin .... barrels	2,396,498	4,817,205	2,585,108	6,621,870	2,310,275	7,069,084	2,438,556	9,899,080	2,560,966	11,327,091
Tar .... do	18,622	50,802	15,644	44,944	20,291	60,520	16,821	55,362	16,792	57,215
Turpentine and pitch ... do	15,972	36,379	13,177	32,253	24,971	74,938	14,232	43,875	19,830	60,563
Turpentine, spirits of. gallons	16,378,787	8,014,322	17,202,808	9,446,155	15,894,813	8,902,101	15,981,253	10,077,268	15,854,676	10,241,883
Total	....	12,918,708	....	16,145,222	....	16,106,643	....	20,075,585	....	21,686,752
Wood—										
Timber—										
Round	....	4,506,728	....	4,473,297	....	3,040,846	....	3,866,300	....	3,645,180
Hewn .... cubic feet	3,291,498	787,082	3,788,740	881,557	3,856,623	913,654	3,517,046	877,786	3,278,110	890,106
Sawed .... M feet	530,659	7,462,111	558,690	8,472,355	486,411	7,294,168	552,548	10,649,310	600,865	13,101,178
Total timber	....	12,755,921	....	13,827,209	....	11,248,668	....	15,393,396	....	17,636,464
Lumber—										
Boards, deals, and planks, M feet	1,065,771	20,965,328	1,426,784	28,603,355	1,283,406	24,483,214	1,344,607	28,695,823	1,623,964	39,861,352
Joists and scantling, M feet	46,894	647,920	60,119	875,062	47,309	704,305	29,119	501,711	34,851	752,152
Shingles .... M	38,211	86,245	28,484	82,377	24,345	69,251	26,272	73,635	18,256	53,261
Shooks—										
Box	....	779,777	....	869,802	....	825,145	....	954,268	....	939,724
Other .... number	566,205	829,248	533,182	795,595	872,192	1,278,972	1,066,253	1,524,549	803,346	1,409,595
Total shooks	....	1,609,025	....	1,665,397	....	2,104,117	....	2,478,817	....	2,349,319
Staves and heading—										
Heading	....	134,383	....	170,874	....	148,042	....	201,219	....	157,553
Staves .... number	55,879,010	4,740,680	47,420,095	4,032,344	48,286,285	3,613,635	57,586,378	4,699,877	51,120,171	5,127,522
Total staves and heading	....	4,875,063	....	4,203,218	....	3,761,677	....	4,901,096	....	5,285,075
Other	....	3,732,782	....	3,190,687	....	3,068,115	....	3,317,164	....	3,578,452

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Total lumber	....	31,916,363	....	38,620,096	....	34,190,679	....	39,968,246	....	51,879,011
Total wood	....	44,672,284	....	52,447,305	....	45,439,347	....	55,361,642	....	69,516,075
Wood alcohol[b] ....proof gallons	833,629	452,892	1,194,466	585,359	1,097,451	603,385	780,222	466,467	2,150,311	862,819
Wood pulp ....pounds	22,464,472	445,228	30,230,820	593,474	23,703,906	473,585	29,482,434	587,878	25,079,946	498,552
Total forest products	....	58,281,124	....	70,085,789	....	63,199,348	....	76,975,431	....	92,948,705
Fruits:										
Fresh or dried—										
Apples, fresh ....barrels	1,656,129	4,381,801	2,018,262	5,446,473	1,499,942	3,859,375	1,208,989	3,751,375	1,539,267	4,652,966
Apples, dried ....pounds	39,646,297	2,378,635	48,301,665	2,791,421	39,272,890	2,208,414	27,852,831	2,044,820	45,697,948	3,166,946
Apricots, dried ....do	9,190,081	713,887	7,205,686	608,511	6,854,154	606,777	13,760,281	1,325,422	2,760,432	336,812
Oranges	....	465,397	....	739,593	....	(a)	....	1,110,993	....	1,255,104
Peaches, dried ....pounds	(a)	(a)	(a)	(a)	(a)	(a)	1,181,649	110,407	1,757,650	186,043
Pears, fresh	....	(a)	....	(a)	....	929,151	....	631,972	....	675,944
Prunes ....pounds	66,385,215	3,512,507	73,146,214	3,410,497	54,993,849	2,455,056	24,869,744	1,410,636	44,400,104	2,400,960
Raisins ....do	4,280,028	284,530	4,020,418	281,402	7,054,824	372,087	4,528,502	305,768	9,128,827	599,398
Other	....	4,215,034	....	4,317,910	....	2,253,638	....	1,727,943	....	2,246,384
Total fresh or dried	....	15,951,791	....	17,595,807	....	12,684,498	....	12,419,336	....	15,520,557
Preserved—										
Canned	....	1,739,571	....	2,637,002	....	2,541,025	....	2,348,064	....	1,581,047
Other	....	66,757	....	115,490	....	71,868	....	89,872	....	104,663
Total preserved	....	1,806,328	....	2,752,492	....	2,612,893	....	2,437,936	....	1,685,710
Total fruits	....	17,758,119	....	20,348,299	....	15,297,391	....	14,857,272	....	17,206,267
Ginseng ....pounds	151,985	796,008	131,882	851,820	146,576	1,069,849	160,949	1,175,844	117,696	813,023
Glucose and grape sugar ....do	126,239,981	2,460,022	152,768,716	2,949,545	175,250,580	3,206,794	189,656,011	3,489,192	151,629,441	3,017,527
Grain and grain products:										
Grain—										
Barley ....bushels	8,429,141	4,662,544	10,881,627	6,292,914	10,661,655	5,585,544	17,729,360	8,653,231	8,238,842	4,556,295
Buckwheat ....do	117,953	75,713	31,006	19,827	316,399	209,941	696,513	449,129	199,429	128,837
Corn (maize) ....do	74,833,237	40,540,637	55,858,965	30,071,334	88,807,223	47,446,921	117,718,657	62,061,856	83,300,708	44,261,816
Oats ....do	4,613,809	1,850,728	1,153,714	475,362	5,479,308	2,085,992	46,324,935	16,234,918	4,014,042	1,670,881
Rye ....do	5,422,731	3,143,910	765,108	440,980	1,423	1,191	1,355,528	905,350	749,455	562,016
Wheat ....do	114,181,420	87,795,104	44,230,169	35,850,318	4,394,402	3,905,579	34,973,291	28,757,517	76,569,423	60,214,388
Total grain ....do	207,598,291	138,068,636	112,920,589	73,150,735	109,660,410	59,235,168	218,798,284	117,062,001	173,071,899	111,394,233
Grain products—										
Bran, middlings, and mill feed, tons	49,513	945,053	19,193	366,213	36,293	722,582	99,418	2,052,285	92,675	2,115,848
Breadstuff preparations	....	3,256,945	....	2,807,704	....	2,710,699	....	2,868,837	....	2,638,263

[a] Not separately stated.
[b] Classed as agricultural for the first time in 1904; the statistics for earlier years are not included in the total domestic exports of forest products, 1903.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1907—Continued.

Article exported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Grain and grain products—Cont'd.										
Grain products—										
Distillers' and brewers' grains and malt sprouts .....tons..	73,104	$1,320,065	56,038	$1,062,336	75,549	$1,485,671	102,683	$1,937,315	84,581	$1,617,850
Malt.................bushels..	347,147	252,801	438,580	315,676	487,158	342,851	881,523	598,453	414,515	278,448
Meal and flour—										
Corn meal........barrels..	451,506	1,382,127	590,774	1,691,669	371,565	1,113,295	543,794	1,623,397	766,880	2,313,410
Oatmeal.........pounds..	67,823,935	1,839,106	14,526,477	463,062	52,476,917	1,423,742	37,972,903	948,088	42,701,257	1,122,162
Rye flour........barrels..	3,757	12,818	3,160	11,302	4,721	19,618	5,383	20,019	3,377	10,879
Wheat flour........do....	19,716,484	73,756,404	16,999,432	68,894,836	8,826,335	40,176,136	13,919,048	59,106,869	15,584,667	62,175,397
Total meal and flour....	....	76,990,455	....	71,060,869	....	42,732,791	....	61,698,373	....	65,621,848
All other	....	661,131	....	602,521	....	845,999	....	850,090	....	732,660
Total grain products.......	....	83,426,450	....	76,215,319	....	48,840,593	....	70,005,353	....	73,004,917
Total grain and grain products	....	221,495,086	....	149,366,054	....	108,075,761	....	187,067,354	....	184,399,150
Grasses, dried.........................	....	15,294	....	8,762	....	11,138	....	9,805	....	11,670
Hay ....tons..	50,974	828,483	60,730	1,052,705	66,557	1,089,505	70,172	1,116,307	58,602	976,287
Hops ....pounds..	7,794,705	1,909,951	10,985,988	2,116,180	14,858,612	4,480,666	13,026,904	3,125,843	16,809,534	3,531,972
Lard compounds. (*See* Meat and meat products.)										
Liquors, alcoholic:										
Distilled spirits—										
Alcohol, including cologne spirits.......proof gallons..	120,697	23,510	587,549	112,299	1,081,871	223,664	504,665	103,833	428,107	70,814
Brandy..................do....	18,117	19,213	70,193	44,111	21,171	18,217	5,145	8,553	14,172	22,496
Rum.....................do....	1,096,719	1,458,393	757,227	994,959	911,371	1,175,837	701,423	877,922	914,074	1,191,418
Whisky—										
Bourbon............do....	169,396	203,137	231,540	254,693	212,001	246,115	183,621	245,264	190,067	253,222
Rye..................do....	104,236	223,480	127,535	217,551	106,893	207,606	109,522	207,783	134,110	252,918
Total whisky...do....	273,632	426,617	359,075	472,244	318,894	453,721	293,143	453,047	324,177	506,140
Other..................do....	48,014	62,358	47,402	67,854	83,771	97,328	40,089	81,870	19,779	36,889

Total distilled spirits.do....	1,557,179	1,990,091	1,821,446	1,691,467	2,417,078	1,968, 67	1,544,465	1,525,225	1,700,309	1,827,757
Malt liquors—										
Unbottled............gallons..	400,072	95,758	382,346	84,687	354,097	80,436	256,575	57,192	356,788	87,114
Bottled.......dozen quarts..	759,027	1,082,982	540,301	769,432	626,400	932,372	727,731	1,059,584	743,163	1,128,226
Total malt liquors........	....	1,178,740	....	854,119	....	1,012,808	....	1,116,776	....	1,215,340
Wines—										
Unbottled............gallons..	678,150	290,552	896,643	403,557	839,386	355,215	789,526	326,335	560,147	251,353
Bottled........dozen quarts..	5,232	24,624	6,066	33,136	5,800	28,242	5,596	25,215	4,404	20,128
Total wines...............	....	315,176	....	436,693	....	383,457	....	351,550	....	271,481
Total alcoholic liquors....	....	3,484,007	....	2,982,279	....	3,365,032	....	2,993,551	....	3,314,578
Malt. (*See* Grain and grain products.)										
Malt liquors. (*See* Liquors alcoholic.)										
Malt sprouts. (*See* Grain and grain products.)										
Nursery stock..............	....	158,959	....	287,880	....	219,223	....	242,056	....	225,339
Nuts:										
Peanuts.................pounds..	(a)	(a)	(a)	(a)	(a)	(a)	7,180,163	275,927	6,386,012	278,236
Other..........................	....	(a)	....	(a)	....	(a)	....	140,959	....	103,929
Total nuts....................	....	299,558	....	330,366	....	309,195	....	416,886	....	382,165
Oil cake and oil-cake meal:										
Corn.....................pounds..	8,093,222	95,568	14,014,885	169,921	24,171,127	278,526	48,420,942	605,346	56,808,972	677,156
Cottonseed..................do....	1,100,392,988	12,732,497	820,349,073	9,134,088	1,251,907,996	13,897,178	1,110,834,678	13,073,100	1,340,967,136	17,062,594
Flaxseed, or linseed.........do....	570,908,149	7,011,214	668,868,722	7,765,169	618,498,525	7,600,907	758,916,364	10,313,118	665,936,164	8,675,877
Total.....................do....	1,679,394,359	19,839,279	1,503,232,680	17,069,178	1,894,577,648	21,776,611	1,918,171,984	23,991,564	2,063,712,272	26,415,627
Oils, vegetable:										
Fixed or expressed—										
Corn..................gallons..	3,788,035	1,467,493	3,222,875	998,613	3,108,917	890,937	3,833,251	1,172,206	3,041,269	1,083,929
Cottonseed..............do....	35,642,994	14,211,244	29,013,743	10,717,280	51,535,580	15,125,802	43,793,519	13,673,370	41,880,304	17,074,403
Linseed..................do....	182,330	98,116	336,419	147,721	282,188	125,354	312,766	150,395	450,208	203,712
Other..........................	....	169,796	....	189,451	....	139,219	....	244,267	....	430,965
Total fixed or expressed.....	....	15,946,649	....	12,053,065	....	16,281,312	....	15,240,238	....	18,793,009
Volatile, or essential—										
Peppermint..........pounds..	13,033	34,943	42,939	124,728	36,953	135,060	74,151	206,261	147,722	499,082
Other..........................	....	252,770	....	440,588	....	215,860	....	459,532	....	258,423
Total volatile, or essential...	....	287,713	....	565,316	....	350,920	....	665,793	....	757,505
Total vegetable oils..........	....	16,234,362	....	12,618,381	....	16,632,232	....	15,906,031	....	19,550,514

a Not stated.

Agricultural exports (domestic) of the United States during the five years ending June 30, 1907—Continued.

Article exported.	1903.		1904.		1905.		1906.		1907.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Rice, rice meal, etc.:										
Rice.......pounds..	532,092	$27,048	2,380,418	$88,465	74,866,965	$2,254,446	3,969,722	$138,853	2,443,008	$84,681
Rice bran, meal, and polish, pounds	19,218,356	122,589	26,741,345	200,263	38,415,795	266,891	34,172,331	255,265	27,731,363	259,521
Rice hulls								101,754		113,071
Total.......pounds..	19,750,448	149,637	29,121,763	288,728	113,282,760	2,521,337		495,872		457,273
Root beer.......dozen quarts..	949	834	456	455	332	358	3,276	3,615	1,756	1,846
Roots, herbs, and barks, n. e. s.		320,122		266,809		339,083		364,411		413,799
Seeds:										
Cotton.......pounds..	51,622,370	532,732	12,859,756	141,174	21,101,129	235,833	23,717,326	268,330	17,628,111	209,493
Flaxseed, or linseed.......bushels..	4,128,130	5,698,492	758,379	820,668	1,338	1,738	5,988,519	7,495,748	6,336,310	7,990,383
Grass seed—										
Clover.......pounds..	15,522,527	1,549,687	6,440,618	600,626	10,657,365	1,114,015	2,265,760	267,258	3,989,798	420,104
Timothy.......do....	18,289,917	853,829	12,672,676	480,946	16,141,269	584,618	11,247,080	385,454	18,616,834	813,224
Other		581,773		299,649		303,989		217,995		397,493
Total grass seed		2,985,289		1,381,221		2,002,622		870,707		1,630,821
All other seeds		238,770		240,262		317,554		277,877		263,912
Total seeds		9,455,283		2,583,325		2,557,747		8,912,662		10,094,609
Spices		36,787		28,521		32,372		66,970		50,111
Spirits, distilled. (*See* Liquors, alcoholic.)										
Starch.......pounds..	27,759,599	832,943	57,185,739	1,340,282	61,450,444	1,430,572	66,574,881	1,490,797	51,334,580	1,126,465
Straw		1,747		4,607		7,342		7,381		7,482
Sugar, molasses, and sirup:										
Molasses.......gallons..	3,413,387	492,260	3,819,139	592,288	4,384,863	591,879	10,205,885	977,097	3,193,322	297,493
Sirup.......do....	12,265,295	1,714,899	12,901,957	1,846,563	13,337,423	2,076,200	12,335,645	1,975,856	14,115,819	2,050,964
Sugar—										
Raw.......pounds..	99,101	3,545	113,977	3,427	25,099	969	276,556	7,797	58,587	1,812
Refined.......do....	10,421,055	358,537	15,304,560	528,616	18,322,978	745,639	21,899,290	823,221	21,179,016	829,350
Total sugar.......do....	10,520,156	362,082	15,418,537	532,043	18,348,077	746,608	22,175,846	831,018	21,237,603	831,162

Total sugar, molasses, and sirup	....	2,569,241	....	2,970,894	....	3,414,687	....	3,783,971	....	3,179,619
Teasels	....	34,258	....	23,459	....	6,929	....	5,012	....	550
Tobacco:										
Leaf .... pounds	357,496,342	34,972,033	305,382,128	29,464,732	328,232,009	29,644,547	302,333,075	28,602,452	331,548,309	33,193,881
Stems and trimmings .... do	10,687,742	278,860	6,589,703	176,080	6,070,082	156,269	9,894,127	205,915	9,194,555	183,517
Total .... do	368,184,084	35,250,893	311,971,831	29,640,812	334,302,091	29,800,816	312,227,202	28,808,367	340,742,864	33,377,398
Vegetables:										
Fresh or dried—										
Beans and pease .... bushels	232,841	530,875	248,805	546,479	330,321	730,922	447,474	960,710	435,490	932,264
Onions .... do	145,509	116,624	144,764	116,104	234,048	209,938	205,102	182,060	257,747	217,582
Potatoes .... do	843,075	552,533	484,042	436,135	1,163,270	750,210	1,000,326	743,993	1,530,461	1,278,034
Total fresh or dried .... do	1,221,425	1,200,032	877,611	1,098,718	1,727,639	1,691,070	1,652,902	1,886,763	2,223,698	2,427,880
Prepared or preserved—										
Canned	....	597,759	....	719,580	....	580,048	....	658,739	....	598,628
Other	....	745,697	....	785,076	....	929,742	....	1,021,625	....	981,325
Total prepared or preserved	....	1,343,456	....	1,504,656	....	1,509,790	....	1,680,364	....	1,579,953
Total vegetables	....	2,543,488	....	2,603,374	....	3,200,860	....	3,567,127	....	4,007,833
Vinegar .... gallons	103,417	18,072	132,450	19,192	111,994	17,158	92,027	16,266	81,752	13,274
Wines. (*See* Liquors, alcoholic.)										
Yeast	....	24,675	....	18,772	....	21,215	....	23,099	....	38,465
Total vegetable matter, including forest products	....	715,763,473	....	696,211,844	....	666,103,329	....	784,218,428	....	892,555,792
Total vegetable matter, excluding forest products	....	657,482,349	....	626,126,055	....	602,903,981	....	707,242,997	....	799,607,087
Total agricultural exports, including forest products	....	936,761,681	....	929,246,053	....	890,104,125	....	1,053,022,535	....	1,147,354,121
Total agricultural exports, excluding forest products	....	878,480,557	....	859,160,264	....	826,904,777	....	976,047,104	....	1,054,405,416

Value of the domestic exports, total and farm products, 1851–1907.[a]

Year ending June 30—	Total.	Farm products.	Year ending June 30—	Total.	Farm products.
1851	$178,620,138	$146,717,431	1881	$883,925,947	$738,123,799
1852	154,931,147	125,183,749	1882	733,239,732	557,620,540
1853	189,869,162	155,461,445	1883	804,223,632	626,426,608
1854[b]	213,985,236	172,320,260	1884	724,964,852	547,952,579
1855	192,751,135	149,101,277	1885	726,682,946	554,051,145
1856	266,438,051	222,409,001	1886	665,964,529	501,313,738
1857	278,906,713	232,180,205	1887	703,022,923	536,938,387
1858	251,351,033	205,853,748	1888	683,862,104	505,402,327
1859	278,392,080	226,135,020	1889	730,282,609	536,828,565
1860	316,242,423	260,280,403	1890	845,293,828	634,855,869
Annual average, 1851–1860	232,148,712	189,564,254	Annual average, 1881–1890	750,146,310	573,951,356
1861	204,899,616	154,094,839	1891	872,270,283	652,407,931
1862	182,024,868	142,553,180	1892	1,015,732,011	803,122,045
1863	249,891,436	187,299,863	1893	831,030,785	621,201,671
1864	219,561,637	158,562,252	1894	869,204,937	636,633,747
1865[c]	259,125,063	170,092,003	1895	793,392,599	558,385,861
1866	468,040,903	391,390,838	1896	863,200,487	574,398,264
1867[d]	383,601,116	298,963,149	1897	1,032,007,603	689,755,193
1868	370,555,738	285,440,046	1898	1,210,291,913	859,018,946
1869	371,045,149	278,978,797	1899	1,203,931,222	792,811,733
1870	455,208,341	363,648,647	1900	1,370,763,571	844,616,530
Annual average, 1861–1870	316,395,387	243,102,362	Annual average, 1891–1900	1,006,182,541	703,235,192
1871	478,115,292	370,841,939	1901	1,460,462,806	951,628,331
1872	476,421,478	371,647,725	1902	1,355,481,861	857,113,533
1873	575,227,017	450,783,841	1903	1,392,231,302	878,480,557
1874	633,339,368	505,504,952	1904	1,435,179,017	859,160,264
1875	559,237,638	435,961,599	1905	1,491,744,641	826,904,777
1876	594,917,715	465,167,063	1906	1,717,953,382	976,047,104
1877	632,980,854	467,551,262	1907	1,853,718,034	1,054,405,416
1878	695,749,930	544,242,826			
1879[e]	698,988,742	558,385,583			
1880	823,946,353	694,315,497			
Annual average, 1871–1880	616,892,439	486,440,229			

[a] Values for 1862 to 1879 represent mixed values, partly currency and partly gold, exports from the Pacific ports having been returned in gold, while exports from other ports were returned in currency. The average annual value in currency of a dollar in gold for the years in question was as follows: 1862, $1.016; 1863, $1.371; 1864, $1.562; 1865, $2.019; 1866, $1.404; 1867, $1.41; 1868, $1.399; 1869, $1.375; 1870, $1.233; 1871, $1.127; 1872, $1.118; 1873, $1.146; 1874, $1.12; 1875, $1.127; 1876, $1.139; 1877, $1.079; 1878, $1.025; 1879, $1.002.

[b] Excluding $1,343,064 of exports from San Francisco reported too late for inclusion.

[c] Including $17,436,429 ($2,001,192 agricultural) of exports from New Orleans and San Francisco according to corrected report of succeeding year.

[d] Excluding $2,144,916 of exports from San Francisco reported too late for inclusion.

[e] Excluding $550,000 of silkworm eggs reported in original returns as domestic instead of foreign.

LEGAL WEIGHTS PER BUSHEL.

[From Bureau of Standards, Department of Commerce and Labor.]

Legal weights (in pounds) per bushel.

State or Territory.	Apples.		Barley.	Beans.		Beets.	Blue-grass seed.	Bran.*	Broom-corn seed.	Buckwheat.	Carrots.	Clover seed.	Coal.	Coke.	Corn.		Corn meal.*	Corn meal, bolted.	Corn meal, unbolted.
	Apples.*	Dried apples.		Beans.*	Castor beans, shelled.										Corn in ear.	Shelled corn.			
U. S			48		50					42			80				48		
Ala		24	47	60											70	56	46		48
Ariz			45	a 55												54			
Ark	b 50	24	48	a 60			14	20	48	52		60			70	56	48		
Cal			50							40						52			
Colo			48	60			14			52		60	80		70	56	50		
Conn	48	25	48	60		c 60		20		48	50	60	80			56			
Del																56		44	48
Fla	b 48	24	48	d 60	48			20							70	56	48		
Ga		24	47	e 60			14	f 20		52		60	80		70	56	48		
Hawaii			48													56			
Idaho	b 45	28	48							42		60				56			
Ill		24	48	e 60	46		14	20		52		60	80		70	56	48		
Ind		25	48	60	46		14			50		60	80		g 68	56	50		
Iowa	48	24	48	60	46		14	20	30	52		60	80	38	70	56			
Kans	b 48	24	48	60	46		h 14	20		50		60	80		70	i 56	50		
Ky		24	47	e 60	* 45		14	20		56		60	76		j 70	56	50		
La			48													56			
Me	44		48	60		60				48	50					56	50		
Mass	48	25	48	k 60				20		48	50	60				l 56	50		
Mich	48	22	48	60	46		14			48		60	80		70	56	50		
Minn	b 50	28	48	60		50	14		57	50	45	60	80		70	56			
Miss		26	48	e 60	46		14	20		48		60	80		72	56	48	44	48
Mo	48	24	48	m 60	46		14	20		52	50	60	80		70	56	50		
Mont	45		48	60		50	14	20		52	50	60	76		70	56	50		
Nebr		24	48	e 60	46		14	20		52		60	80		70	56	50		
N. H				62												56	50		
N. J	50	25	48	60						50		64				56			
N. Y	48	25	48	60				20		48	50	60				56	50		
N. C			48							50		60				56		46	48
N. Dak	50		48	60		60		20	30	42		60	80		70	56			
Ohio	50	24	48	60		56				50	50	60	n 80	40	68	56			
Okla			48	60		60		20	30	42		60	80		70	56			
Oreg	45	28	46							42		60				56			
Pa			47							48		60	o 76	40		56			
R. I	48	25	48	60	46	50		20		48	50	60	80	40	70	56	50		
S. C																	48	46	48
S. Dak			48	60		60		20	30	42		60	80		70	56			
Tenn	b 50	24	48	p 60	46	50	14	20	42	50	50	q 60	80	40	70	56		50	48
Tex	45	28	48	e 60				20		42		60	80		70	56			
Vt	46		48	62		60				48	50	60				56			
Va		28	48	e 60			14			52		60	80		70	56	50		
Wash	b 45	28	48							42		60				56			
W. Va		25	48	60						52		60	80			56			
Wis	50	25	48	60		50		20		50	50	60				56	50		

* Not defined.
a Small white beans, 60 pounds.
b Green apples.
c Sugar beets and mangel-wurzels.
d Shelled beans, 60 pounds; velvet beans, 78 pounds.
e White beans.
f Wheat bran.
g Corn in ear, 70 pounds until Dec. 1 next after growth; 68 pounds thereafter.
h English blue-grass seed, 22 pounds; native blue-grass seed, 14 pounds.
i Rice corn.
j Corn in ear from Nov. 1 to May 1 following, 70 pounds; 68 pounds from May 1 to Nov. 1.
k Soy beans. 58 pounds.
l Cracked corn, 50 pounds.
m Green unshelled beans, 30 pounds.
n Cannel coal, 70 pounds.
o Standard weight in borough of Greensburg, 75 pounds per bushel.
p Dried beans; green unshelled beans, 30 pounds.
q Red and white.

Legal weights (in pounds) per bushel—Continued.

State or Territory.	Cotton seed.		Cranberries.	Flaxseed (linseed).	Gooseberries.	Plastering hair.	Hemp seed	Herds—grass.	Hungarian grass seed.	Millet.	Oats	Onions.		Orchard grass seed.	Osage orange seed.	Parsnips	Peaches		
	Cottonseed.*	Sea Island.										Onions.*	Onion sets.				Peaches.*	Dried, peeled.	Dried, unpeeled.
U. S.				56							32								
Ala.	32										32							38	33
Ariz.											32								
Ark.	33½			56						50	32	57						33	33
Cal.											32								
Colo.							44				32	57							
Conn.	30	44		55				45			32	52				45		33	33
Fla.	32	46								50	32	56					a 54	33	
Ga.	30			56		8	44				32	57						38	33
Hawaii.											32								
Idaho.				56							36								28
Ill.				56		8	44				32	57							33
Ind.			33				44			50	32	48		14	33	55			33
Iowa.				56	40		44		50	50	32	57			32		48		33
Kans.				56		b 8	44		50	50	32	57							33
Ky.				56		8	44		50	50	32	57	c 36	14				39	
Me.						11		45			32	52				45			
Md.											26								
Mass.	30	44		55				45			32	52						33	
Mich.			40	56			44		50	50	32	54		14	33			28	
Minn.			36		40	b 8	50		48	48	32	52		14		42		28	
Miss.	32			56			44		50	50	32	57						33	
Mo.	33			56			44		48	50	32	57	d 28	14	36	44	48	33	
Mont.				56			44		50		32	57				50			
Nebr.				56		8	44		50	50	32	57	25		32			33	
N. H.											32								
N. J.				55							30	57						33	
N. Y.	30	44		55				45			32	57						33	
N. C.	30			55							32								
N. Dak.				56						50	32	52							
Ohio.				56			44		50	50	32	55					48	33	
Okla.				56							32	52							
Oreg.											32							28	
Pa.											32	50							
R. I.	30	44		56			44		50	50	32	50				50	48	33	
S. C.	30																		
S. Dak.				56							32	52							
Tenn.	28			56	48	8	44		48	50	32	56	e 28	14	33	50	f 50	26	
Tex.	32			56			44		48	50	32	57					50	28	
Vt.								45			32	52							
Va.	32			56		8	44		48	50	30	57	28	14	34			40	32
Wash.				56							32							28	
W. Va.				56							32							33	
Wis.	30	44		56		8	44		48	50	32	57				44		33	

*Not defined.
a Green.
b Unwashed plastering hair, 8 pounds; washed plastering hair, 4 pounds.
c Bottom onion sets.
d Top onion sets.
e Button onion sets, 32 pounds.
f Matured.

Legal weights (in pounds) per bushel—Continued.

State or Territory.	Peanuts.	Pears.*	Pease.		Potatoes.	Sweet potatoes.	Redtop seed.	Rough rice.	Rutabagas.	Rye meal.	Rye.	Shorts.*	Sorghum seed.	Tomatoes.	Timothy seed.	Turnips.	Wheat.
			Green pease, unshelled.	Pease.*													
U. S.	....	....	....	60	60	....	....	....	....	....	56	....	....	....	....	....	60
Ala.	....	....	....	60	60	55	....	....	....	....	56	....	....	....	....	55	60
Ariz.	....	....	....	....	....	....	....	....	....	....	56	....	....	....	....	....	60
Ark.	....	....	....	60	60	50	14	....	....	....	56	....	50	....	60	57	60
Cal.	....	....	....	....	....	....	....	....	....	....	54	....	....	....	....	....	60
Colo.	....	....	....	....	60	....	....	....	....	....	56	....	....	....	45	....	60
Conn.	....	....	....	60	60	54	....	45	60	50	56	20	....	....	....	50	60
D. C.	....	....	....	....	60	....	....	....	....	....	....	....	....	....	....	....	....
Del.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	60
Fla.	....	....	....	....	60	60	....	....	....	....	56	....	56	....	....	54	60
Ga.	....	....	....	60	60	55	....	43	....	....	56	....	....	....	45	55	60
Hawaii.	22	60	....	....	....	....	....	....	....	....	56	....	....	....	....	....	60
Idaho.	....	[a] 45	....	....	60	....	....	....	....	....	56	....	....	....	....	....	60
Ill.	....	....	....	....	60	50	....	....	....	....	56	....	....	....	45	55	60
Ind.	....	....	....	....	60	55	....	....	....	....	56	....	....	....	45	55	60
Iowa.	....	....	....	....	60	46	....	....	....	....	56	....	[b] 30	....	45	....	60
Kans.	....	....	....	....	60	50	....	....	....	....	56	....	56	....	45	55	60
Ky.	....	....	....	60	60	55	....	....	....	....	56	....	....	....	45	60	60
La.	....	....	....	....	....	....	....	....	....	....	56	....	....	....	....	....	60
Me.	....	....	....	60	60	....	....	....	60	50	50	....	....	....	....	50	60
Md.	....	....	....	....	56	....	....	....	....	....	....	....	....	60	....	....	....
Mass.	....	....	....	60	60	54	....	45	....	50	56	20	....	....	45	....	60
Mich.	....	....	....	60	60	56	14	....	....	....	56	....	....	....	45	58	60
Minn.	....	....	....	60	60	55	14	....	52	....	56	....	57	....	45	....	60
Miss.	....	....	....	60	60	60	....	....	....	....	56	....	42	....	45	55	60
Mo.	....	48	56	[c] 60	60	56	14	....	50	....	56	....	42	45	45	42	60
Mont.	....	45	....	60	60	....	....	....	....	....	56	....	....	....	45	50	60
Nebr.	....	....	....	60	60	50	....	....	....	....	56	....	30	....	45	55	60
N. H.	....	....	....	60	60	....	....	....	....	50	56	....	....	....	....	....	60
N. J.	....	....	....	60	60	54	....	....	....	....	56	....	....	....	....	....	60
N. Y.	....	....	....	60	60	54	....	45	....	50	56	20	....	....	45	....	60
N. C.	22	....	....	60	....	....	....	44	....	....	56	....	....	....	....	....	60
N. Dak.	....	....	....	60	60	46	....	....	....	....	56	....	....	....	45	60	60
Ohio.	....	....	....	60	60	50	....	....	....	....	56	....	....	56	45	60	60
Okla.	....	....	....	60	60	46	....	....	....	....	56	....	....	....	42	60	60
Oreg.	....	45	....	....	60	....	....	....	....	....	56	....	....	....	....	....	60
Pa.	....	....	....	....	56	....	....	....	....	....	56	....	....	....	....	....	60
R. I.	....	....	....	[c] 60	60	54	....	....	....	50	56	20	....	56	45	50	60
S. Dak.	....	....	....	60	60	46	....	....	....	....	56	....	....	....	42	60	60
Tenn.	23	[d] 56	30	60	60	50	14	....	....	....	56	....	50	56	45	50	60
Tex.	....	....	....	....	60	55	....	....	....	....	56	....	....	55	45	55	60
Vt.	....	....	....	60	60	....	....	....	....	....	56	....	....	....	45	60	[e] 60
Va.	22	....	....	60	56	56	12	....	....	....	56	....	....	....	45	55	60
Wash.	....	[a] 45	....	....	60	....	....	....	....	....	56	....	....	....	....	....	60
W. Va.	....	....	....	....	60	....	....	....	....	....	56	....	....	....	45	....	60
Wis.	....	....	....	60	60	54	....	45	56	50	56	20	....	....	45	42	60

* Not defined.
[a] Green.
[b] Sorghum saccharatum seed.
[c] Including split pease.
[d] Dried pears, 26 pounds.
[e] India wheat, 46 pounds.

Commodities for which legal weights per bushel have been fixed in but one or two States.

[From Bureau of Standards, Department of Commerce and Labor.]

Article.	Weight.	States.
	Pounds.	
Apple seeds	40	Rhode Island and Tennessee.
Beggar-weed seed	62	Florida.
Blackberries	32	Iowa. Tennessee, 48 pounds; dried, 28 pounds.
Blueberries	42	Minnesota.
Bromus inermis	14	North Dakota.
Cabbage	50	Tennessee.
Canary seed	60	Do.
Cantaloupe melon	50	Do.
Cement	80	Do.
Cherries	40	Iowa. Tennessee, with stems, 56 pounds; without stems, 64 pounds.
Chestnuts	50	Tennessee. Virginia, 57 pounds.
Chufa	54	Florida.
Cottonseed, long staple	42	South Carolina.
Cucumbers	48	Missouri and Tennessee. Wisconsin, 50 pounds.
Currants	40	Iowa and Minnesota.
Feed	50	Massachusetts.
Grapes	40	Iowa. Tennessee, with stems, 48 pounds; without stems, 60 pounds.
Guavas	54	Florida.
Hickory nuts	50	Tennessee.
Hominy	60	Ohio. Tennessee, 62 pounds.
Horseradish	50	Tennessee.
Italian rye-grass seed	20	Do.
Johnson-grass seed	28	Arkansas.
Kafir corn	56	Kansas.
Kale	30	Tennessee.
Land plaster	100	Do.
Middlings, fine	40	Indiana; coarse, 30 pounds.
Millet, Japanese barnyard	35	Massachusetts.
Mustard	30	Tennessee.
Plums	40	Florida. Tennessee, 64 pounds.
Plums, dried	28	Michigan.
Pop corn	70	Indiana and Tennessee. Ohio, in the ear, 42 pounds.
Prunes, dried	28	Idaho; green, 45 pounds.
Quinces	48	Florida, Iowa, and Tennessee.
Rape seed	50	Wisconsin.
Raspberries	32	Kansas. Tennessee, 48 pounds.
Rhubarb	50	Tennessee.
Sage	4	Do.
Salads	30	Do.
Sand	130	Iowa.
Spelt or speltz	40	North Dakota. South Dakota, 45 pounds.
Spinach	30	Tennessee.
Strawberries	32	Iowa. Tennessee, 48 pounds.
Sugar-cane seed	57	New Jersey.
Velvet-grass seed	7	Tennessee.
Walnuts	50	Do.

ESTIMATED WOOL CLIP OF THE WORLD, 1901–1906.

Many difficulties beset the preparation of a statement of the wool clip of the world. Each wool-producing country needs to be treated according to the character of the available information, and hence it may be that for one country the census may have ascertained the fact, for another country the production may have been estimated by an expert, for another country it may not be possible to do more than to take exports, and for still another country the best that can be done is to take the number of sheep—itself, perhaps, an estimate—and multiply by a weight per fleece, which may or may not have been determined by commercial experience. The wool included in the following table is that of sheep and lambs, unscoured. No important countries are omitted.

[000 omitted.]

Country.	1901.	1902.	1903.	1904.	1905.	1906.
NORTH AMERICA.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	302,502	316,341	287,450	291,783	295,488	298,915
Canada	11,474	11,331	11,060	10,612	10,275	11,210
Central America and West Indies [a]	1,000	1,000	1,000	1,000	1,000	1,000
Hawaii [b]	424	424	424	424	424	424
Mexico [a]	7,000	7,000	7,000	7,000	7,000	7,000
Newfoundland [c]	199	199	199	199	199	199
Total North America	322,599	336,295	307,133	311,018	314,386	318,748
SOUTH AMERICA.						
Argentina [d]	503,443	436,374	425,468	371,697	421,098	328,731
Brazil [d]	2,216	2,143	1,714	2,182	558	1,130
Chile [d]	9,493	17,016	19,663	19,703	20,754	[e] 20,754
Falkland Islands [d]	4,373	4,360	4,024	4,259	4,251	4,324
Peru [d]	2,400	2,059	2,870	7,951	9,940	[e] 9,940
Uruguay [d]	101,867	95,637	98,124	99,148	72,917	66,837
All other South America [a]	5,000	5,000	5,000	5,000	5,000	5,000
Total South America	628,792	562,589	556,863	509,940	534,518	436,716
EUROPE.						
Austria-Hungary:						
Austria	7,200	7,050	6,900	6,800	6,700	6,600
Hungary	27,600	26,800	26,000	25,500	25,000	[e] 25,000
Bosnia-Herzegovina [a]	10,000	10,000	10,000	10,000	10,000	10,000
Total Austria-Hungary	44,800	43,850	42,900	42,300	41,700	41,600
Bulgaria	21,000	21,750	22,500	23,250	24,000	[e] 24,000
France	90,271	77,507	79,000	78,000	78,000	78,000
Germany	33,600	32,000	30,400	28,800	27,200	25,600
Greece [a]	14,000	14,000	14,000	14,000	14,000	14,000
Italy [a]	21,500	21,500	21,500	21,500	21,500	21,500
Portugal [a]	10,000	10,000	10,000	10,000	10,000	10,000
Roumania [a]	27,500	27,500	27,500	27,500	27,500	27,500
Russia, European	370,000	380,000	375,000	340,000	325,000	320,000
Servia [a]	9,000	9,000	9,000	9,000	9,000	9,000
Spain	53,400	53,100	52,800	52,400	52,000	52,000
Turkey, European [a]	30,000	30,000	30,000	30,000	30,000	30,000
United Kingdom	138,483	135,684	133,124	131,963	130,500	133,088
All other Europe [a]	18,000	18,000	18,000	18,000	18,000	18,000
Total Europe	881,554	873,891	865,724	826,713	808,400	804,288
ASIA.						
British India [a]	50,000	50,000	50,000	50,000	50,000	50,000
Chinese Empire [d]	17,929	25,724	25,751	34,797	46,404	42,253
Persia [d]	11,500	11,500	11,648	10,656	12,146	[e] 12,146
Russia, Asiatic [a]	60,000	60,000	60,000	60,000	60,000	60,000
Turkey, Asiatic [a]	45,000	45,000	45,000	45,000	45,000	45,000
All other Asia [a]	1,000	1,000	1,000	1,000	1,000	1,000
Total Asia	185,429	193,224	193,399	201,453	214,550	210,399

[a] Estimated average production.
[b] Census, 1899.
[c] Census, 1901.
[d] Exports.
[e] Data for 1905.

Estimated wool clip of the world, 1901-1906—Continued.

Country.	1901.	1902.	1903.	1904.	1905.	1906.
AFRICA.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds,*
Algeria	24,000	28,064	29,984	33,052	31,173	33,184
British South Africa: [a]						
Cape of Good Hope	65,210	79,328	65,524	64,372	63,474	71,913
Natal	10,852	9,482	10,991	10,320	13,713	17,870
Total British South Africa	76,062	88,810	76,515	74,692	77,187	89,783
Egypt [b]	3,000	3,000	3,000	3,000	3,000	3,000
Tunis [c]	1,300	420	1,153	1,221	4,161	3,735
All other Africa [b]	10,000	10,000	10,000	10,000	10,000	10,000
Total Africa	114,362	130,294	120,652	121,965	125,521	139,702
OCEANIA.						
Australia:						
New South Wales	301,942	221,566	227,004	249,140	297,154	326,999
Queensland	70,142	41,659	52,984	63,270	69,681	86,364
South Australia	39,952	36,863	46,066	36,986	37,534	44,603
Tasmania	8,939	8,304	5,917	11,562	10,530	11,360
Victoria	74,879	65,490	54,608	80,482	66,350	67,426
Western Australia	14,049	13,378	13,306	12,501	17,720	15,405
Total Australia	509,903	387,260	399,885	453,941	498,969	552,157
New Zealand	164,012	167,448	177,575	179,430	172,975	143,308
All other Oceania [b]	100	100	100	100	100	100
Total Oceania	674,015	554,808	577,560	633,471	672,044	695,565
Total	2,806,751	2,651,101	2,621,331	2,604,560	2,669,419	2,605,418

[a] Figures showing the production of wool for each of the British South Colonies are not available The exports of South African colonial wool from Cape of Good Hope and Natal are here given as representing approximately the total South African wool clip.
[b] Estimated average production.
[c] Exports.
[d] Census, 1899.

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